DOCUMENT RESUME

ED 401 865 HE 029 793

AUTHOR	Chambers, Jack A., Ed.
TITLE	Selected Papers from the National Conference on College Teaching and Learning (5th, Jacksonville, Florida, April 6-9, 1994).
INSTITUTION	Florida Community Coll., Jacksonville. Center for the Advancement of Teaching and Learning.
PUB DATE	94
NOTE	194p.
AVAILABLE FROM	B.J. Schukis, Center for the Advancement of Teaching and Learning, Florida Community College, 501 W. State St. Jacksonville, FL 32202 ($15).
PUB TYPE	Collected Works - Conference Proceedings (021) -- Reports - Descriptive (141)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	Advance Organizers; Classroom Research; *Classroom Techniques; *College Instruction; Computer Assisted Instruction; Computer Literacy; Distance Education; Educational Change; Educational Innovation; Educational Trends; Global Approach; Higher Education; Independent Study; Interactive Television; Internet; Methods Research; Open Education; Professional Development; *Research and Development; Science Curriculum; Student Motivation; Teacher Centers; *Teacher Education; Teacher Workshops; Teaching Methods; *Technological Advancement; Technology Transfer; Theory Practice Relationship

ABSTRACT

This collection of 18 papers covers four broad areas of teaching and learning in higher education: innovative college teaching/learning strategies; effective classroom research/assessment activities; advanced classroom technology; and developing teaching and learning centers. Papers also address the question of how the college classroom is changing and with what degree of success. Titles include: (1) "Implementing Technology in the Higher Education Classroom: Using Self-Directed Learning and Learning Contracts" (Sharon J. Confessore and Shauna C. Grovell); (2) "Teacher Immediacy Behaviors and Student Motivation in the Distance Learning Environment" (James Cunningham and Mary McLemore); (3) "Four Teaching Roles: Enriching Great Teachers" (J'Anne Ellsworth); (4) "Changing the Instructional Environment to Enhance Learning" (Sandra L. Gilchrist); (5) "Mathematical Biology--A Course Using Computer-Aided Instruction" (Thomas J. Herbert); (6) "Teaching an Introductory Programming Course Using Advance Organizers as Learning Aids" (Larry M. Holt); (7) "Enhancing Learning Through Team Work in Information Processing" (Shirley A. Hudson); (8) "Designing Multi-Site Interactive Video Seminars: Experimental Instructional Models Demonstrated" (Otolorin Jones and David L. Elliott); (9) "Teaching Faculty How to Hunt the Internet Treasures" (Kimball B. Kendall and Judith A. Rice); (10) "Going On-Line: Computerized Courses for Distant Learners" (Kathleen King); (11) "Teaching Non-Science Students Computer Science and Technology: Is This Is Old News, Why Aren't We Doing Something About It?" (P.A. Kuntz, et al.); (12) "Reality: Learning Through Community Based Projects" (Leslie H. Lightbourne and Frank M. Bosworth); (13) "Integrating the Electronic

Desktop into the Science Curriculum" (Gary A. Novak and Robert A. Desharnais); (14) "A Teaching Scholars Program to Develop Problem-Solving Molecular Biology Experiments" (Herbert B. Posner and Thomas P. O'Brien); (15) "Classroom Mapping: A Reflective Tool for Thinking About Classroom Technology" (Landra L. Rezabek and Deborah M. Floyd); (16) "Assessment on the Move" (Nick Rushby); (17) "Teaching to Enhance Creativity--Basic Concepts" (Dorothy A. Sisk); (18) "The Global Connection Classroom Project" (David E. Smith and Steven L. Yamshon). (Most papers contain references.) (CH)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED 401 865

THE CENTER
for the ADVANCEMENT of
TEACHING AND LEARNING

presents

SELECTED PAPERS
from the
5TH NATIONAL CONFERENCE
on
COLLEGE TEACHING
AND LEARNING

Edited by
JACK A. CHAMBERS

FLORIDA COMMUNITY COLLEGE
AT JACKSONVILLE

HE 027 793

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN OTHER THAN PAPER COPY HAS BEEN GRANTED BY

Jack A. Chambers
Florida Community Coll, Jacksonville

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☒ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

BEST COPY AVAILABLE

THE CENTER

for the ADVANCEMENT of

TEACHING AND LEARNING

presents

SELECTED PAPERS
from the
5TH NATIONAL CONFERENCE
on
COLLEGE TEACHING
AND LEARNING

Edited by

JACK A. CHAMBERS

FLORIDA COMMUNITY COLLEGE
AT JACKSONVILLE

Copyright, 1994, Florida Community College at Jacksonville. All rights reserved. No part of this publication may be reproduced in any form by any means without prior written permission from the publisher, with the following exceptions: 1) authors of papers published in this volume may reproduce copies of their own articles as indicated in the Publishing Agreement; and
2) reviewers may quote brief passages in review.

Center for the Advancement of Teaching and Learning
Florida Community College at Jacksonville
501 W. State Street
Jacksonville, FL 32202.

CONTENTS

Foreword.....vi

Implementing Technology in the Higher Education Classroom: Using Self-Directed Learning and Learning Contracts
Sharon J. Confessore and
Shauna C. Grovell.....1

Teacher Immediacy Behaviors and Student Motivation in the Distance Learning Environment
James Cunningham and
Mary McLemore.....13

Four Teaching Roles: Enriching Great Teachers
J'Anne Ellsworth.....27

Changing the Instructional Environment To Enhance Learning
Sandra L. Gilchrist.....35

Mathematical Biology -- A Course Using Computer-Aided Instruction
Thomas J. Herbert.....43

Teaching an Introductory Programming Course Using Advance Organizers As Learning Aids
Larry M. Holt.....53

Selected Conference Papers

Enhancing Learning Through Team Work In Information Processing
Shirley A. Hudson.....61

Designing Multi-Site Interactive Video Seminars: Experimental Instructional Models Demonstrated
Otolorin Jones and David L. Elliott.....71

Teaching Faculty How to Hunt the Internet Treasures
Kimball B. Kendall and Judith A. Rice.....83

Going On-Line: Computerized Courses for Distant Learners
Kathleen King.....91

Teaching Non-Science Students Computer Science and Technology: If This is Old News, Why Aren't We Doing Something About It?
P.A. Kuntz, G.P.P. Kuntz and W. Freed.....101

Reality: Learning Through Community Based Projects
Leslie H. Lightbourne and Frank M. Bosworth.....111

Contents

Integrating the Electronic Desktop
Into the Science Curriculum
Gary A. Novak and
Robert A. Desharnais.....121

A Teaching Scholars Program to Develop
Problem-Solving Molecular Biology Experiments
Herbert B. Posner and
Thomas P. O'Brien.....129

Classroom Mapping: A Reflective
Tool for Thinking about Classroom Technology
Landra L. Rezabek and
Deborah M. Floyd.....141

Assessment on the Move
Nick Rushby.....153

Teaching to Enhance Creativity -- Basic Concepts
Dorothy A. Sisk.....161

The Global Connection Classroom Project
David E. Smith and
Steven L. Yamshon.....175

Contributors.....183

FOREWORD

The Center for the Advancement of Teaching and Learning at Florida Community College at Jacksonville was created in 1987 with the belief that classroom teachers should be the primary resource to improve and measure teaching and learning in higher education. The idea for The Center was inspired by a speech given by K. Patricia Cross during FCCJ's "Celebrate Teaching Week" in 1987. FCCJ faculty developed a proposal which resulted in an internally funded grant. A faculty steering committee was then formed to plan and direct The Center's activities.

During its first six years, The Center has sponsored seminars featuring educational leaders; conducted classroom assessment, case writing, teaching portfolio and learning style workshops; sponsored a three-year series of cooperative learning workshops (supported by a grant from the Fund for the Improvement of Postsecondary Education); funded more than sixty FCCJ classroom research grants; and made numerous presentations at national conferences.

In addition to the above, The Center has undertaken a project of significant scope and potentially national impact. In an effort to stimulate creative discussion and promote experimentation to improve the teaching/learning process, The Center decided to provide a national forum featuring recognized educational leaders in diverse areas of teaching and learning. This decision resulted in a commitment by The

Center to sponsor a national conference (now international in scope), as a major, annual project.

For two years, the National Conference on College Teaching and Learning focused on teaching and learning, classroom research, and the development of teaching/learning centers. In its third year, the meeting planners recognized that, since teaching and learning was enhanced by technology, technology also had to become a major focus of the conference. In a cooperative effort with FCCJ's Center for Academic Technology, The Center created a conference track for technology in the college classroom. The technology track proved successful at the Fourth National Conference on College Teaching and Learning, and has subsequently become a permanent part of the conference.

For the fifth conference, the Center's Steering Committee asked itself how the college classroom was changing and, in terms of improved performance, with what degree of success. The Steering Committee also wanted to know, from the technology perspective, what were effective agents, mechanisms, or devices of change. These interests guided the Center as it developed the program for the Fifth National Conference on College Teaching and Learning, held April 6-9, 1994, again in Jacksonville, Florida. The fifth conference yielded the largest and most widely represented field of participants and presenters to date.

This journal contains a wide variety of scholarly articles reporting new or enhanced methods, a number of which involve technology, to improve teaching and

learning in the college classroom. It represents a cross-section of the excellent presentations at the Fifth National Conference from all conference tracks. Many of the ideas lend themselves to immediate application to the classroom. Others may be readily adapted to the classroom with minimal effort and resources. All of the articles should stimulate further thought and discussion on quality college teaching and learning among the journal's readers. These readers include the more than 530 conference participants as well as all others in the post-secondary teaching community who desire to make the college classroom a better place for teaching and learning.

Many people are responsible for the success of the Fifth National Conference on College Teaching and Learning. Thanks to all participants: featured speakers and workshop leaders; presenters from community colleges, colleges, and universities throughout the United States and abroad; and faithful attendees. The Steering Committee for The Center for the Advancement of Teaching and Learning worked for more than a year to plan, develop, and organize the conference. Steering Committee members included June Borden, Mosetta Cohen, Gail Fredrick, Billie Holmes, Bill Martin, Jim Mayes, Maura Scali-Sheehan, Mary Louise Shannon, and Arnold Wood. B.J. Schukis and Debbie Cyphers deserve a special round of applause for their supporting efforts.

The Center also appreciates the dedicated work of Jack Chambers and the Center for Academic Technology at FCCJ who planned the technology program. Grateful thanks also goes to IBM who provided much of the advanced technology for the presentations and contributed in many other ways.

Nearly sixty papers were submitted for consideration for publication in this year's journal. Those that were finally selected for inclusion were juried by FCCJ faculty members listed below, most of whom serve on the Steering Committee of The Center. Selection criteria included:

* Focus of the paper (i.e., teaching, learning, technology)
* Discipline
* Appeal to an audience of professional, post-secondary educators
* Theoretical or practical application
* Quality of writing/adherence to format.

The articles which follow satisfy these criteria.

Selected Conference Papers

Read, enjoy and make use of the articles in this journal as much as you can. Then, as participant or presenter, plan to join us at the Sixth National Conference on College Teaching and Learning, April 5-8, 1995.

Gail Fredrick
Professor of Office
Systems Technology

Maura Scali-Sheehan
Professor of
Cosmetology/Barbering

John Q. Mullins
Professor of Biology

Arnold Wood
Professor of English

x.

IMPLEMENTING TECHNOLOGY IN THE HIGHER EDUCATION CLASSROOM: USING SELF-DIRECTED LEARNING AND LEARNING CONTRACTS

Sharon J. Confessore

and

Shauna C. Grovell

The George Washington University

INTRODUCTION

The use of technology has become commonplace in higher education. Computers, sophisticated satellite systems and fiber-optic delivery of distance education provide today's colleges with different technologies to enhance learning for their students. As with any educational endeavor, success using technology depends on appropriate use of all instructional

methods, even if they are undertaken in a "virtual" environment.

Shale and Garrison (1990) maintain that "a new framework for distance education which will accommodate the blurring of the boundaries across all forms of higher education delivery must inevitably...be based upon an understanding of the essence of the educational transaction" (Shale & Garrison, 1990, p.4). Regardless of the technological sophistication of the delivery mechanism, learning is still a highly personalized transaction between the student and the teacher. This requires continual interaction between the teacher, the learner, and the subject content.

Williams and Paprock (1993) note that the key skills learners must have in the technological age are the ability to manipulate the technology to get access to the information, and the capacity to identify one's own learning needs, evaluate information, and develop self-directed learning capabilities. These observations are supported by Schieman (1990), who maintains that the advantages of interactive strategies include encouraging learners to be more self-directed and supporting problem-centeredness in the learning approach.

There is a need to focus on use of self-directed learning activities when we begin to integrate technology into higher education classrooms. The purpose of this paper is to describe self-directed learning, and provide some guidelines for educators who are interested in using this technique in their classrooms.

SELF-DIRECTED LEARNING

Knowles (1975) defined self-directed learning as: "a process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes" (Knowles, 1975, p. 18).

Although there has been controversy regarding the exact definition of self-directed learning, and what specifically may be considered as "self-directedness" (Long, 1991), there is some agreement that self-directed learning may occur in many different settings, and with varying amounts of learner autonomy. There are many different ways to implement self-directed learning within a classroom setting. This paper discuss two -- the Stages Self Direction Model (SSDL) and the learning contract.

Instructional Control and Instructional Design

Faculty regularly make decisions regarding the amount of control, and instances in which this level of control will be used. Schuttenberg and Poppenhagen (1980) have developed a course continuum which describes instruction using two dimensions: design elements and amount of influence. This chart appears in Table 1.

TABLE 1. Course Design Continuum*

	INSTRUCTOR INFLUENCE		
DESIGN ELEMENTS	**MODEL A**	**MODEL B**	**MODEL C**
1. Learning Objectives	Determined by Instructor	Instructor Provides Options	Instructor Sets Tentative Objectives
2. Course Content	Determined by Instructor	Instructor Provides Options	Instructor Suggests Tentative Content
3. Content Sequence	Determined by Instructor	Instructor Provides Options	Instructor Suggests Tentative Sequence
4. Teaching/Learning Methods	Determined by Instructor	Instructor Provides Options	Instructor Suggests Tentative Methods Procedures
5. Evaluation of Learning	Determined by Instructor	Instructor Provides Options	Instructor Suggests Tentative Evaluation Procedures

LEARNER INFLUENCE		
DESIGN ELEMENTS	**MODEL D**	**MODEL E**
1. Learning Objectives	Learners and Instructor Collaborate	Learners Set Own Learning Objective
2. Course Content	Learners and Instructor Collaborate	Learners Select Content to Meet Objectives
3. Content Sequence	Learners and Instructor Plan Sequence Together	Learners Determine Sequence
4. Teaching/Learning Methods	Learners and Instructor Jointly Develop Methods	Learners Take Responsibility for Methods
5. Evaluation of Learning	Learners and Instructor Work Together on Evaluation	Learners Devise Appropriate Evaluation Methods

*Developed by Ernest M. Schuttenberg, 1980.

This course design continuum identifies five "design elements", and displays how each of these elements are affected as influence shifts from instructor dominated to learner dominated conditions. The instructional situation may thus be described by looking at the combination of the amount of influence exerted on each design element. Although a model has been identified for different amounts of influence exerted for each design element, the capability to select across models is possible. This allows for many different degrees of teacher or student control, and causes different conditions for decision-making in an instructional situation.

Framing the delivery of instruction in this context makes it possible to identify specifically the amount of control appropriate for each design element. It also provides a guide for introducing self-directed activities in the classroom. For example, an instructor may decide to narrow the focus of the course content and learning objectives while leaving the content sequence and teaching methods completely open for the learner to identify. Conversely, an instructor may leave all design elements to the discretion of the learner.

The Staged Self Direction Model

Grow (1991) proposed the Staged Self Direction Model (SSDL). This model, developed specifically for college classrooms "proposes that learners move

through stages on the path to self-directed learning" (Grow, 1991, p. 202).

There are four stages to this model. Stage one is where the students are seen as very dependent and the teacher provides firm authority. Methodology focuses on coaching with immediate feedback. In stage two, students are categorized as interested, and the teacher's role is to serve as motivator. This is done through lecture and guided discussions. In stage three, students are more involved in the educational process, and the teacher takes on a facilitator role and makes use of seminars, group projects, and facilitated discussion. Finally, in stage four, students are characterized as self-directed. In this stage, the teacher serves as consultant, and information is obtained through completion of projects such as individual work, study groups, and internships.

Grow characterized self-directed learners as being able to set their own goals and standards, and as willing to take responsibility for their own learning. They identify and access their own resources, and are autonomous learners. The role of the teacher is to empower the student. This includes such activities as helping the student articulate the learning goals, identify possible resources, and work with the learner through the process of identifying, clarifying, and completing a learning project.

Learning Contracts

Knowles (1975) specified four competencies for the effective implementation of self-directed learning:

1) collaboration between both instructor and students, and among students; 2) assessment of learning need; 3) specifying learning objectives based on the identified learning needs; and 4) selecting effective strategies for acquiring the information.

Knowles (1991) provided a strategy for incorporating all of these competencies into a learning contract. This "contract" provides still another means of implementing self-directed learning into the classroom setting. Knowles viewed the learning contract as a way to address both the external needs and standards of a given class while meeting the students' internal needs and interests.

Developing the learning contract involves eight steps: 1) diagnosis of learning needs; 2) specification of learning outcomes; 3) identification of learning resources and strategies; 4) presentation of evidence of accomplishments; 5) specification of how the evidence will be validated; 6) seeking advice of colleagues and/or experts; 7) completing the terms of the contract; and finally, 8) evaluating the learning experience.

Learning contracts can take many formats, and can be constructed utilizing varying degrees of independence on the part of the student (Hiemstra and Sisco, 1990). The amount of autonomy is determined by the characteristics of the student, the specific information to be learned, and the circumstances surrounding the learning (for example in a classroom, or as part of an internship).

Hiemstra and Sisco (1990) made several recommendations for implementing self-directed and

contract learning. First, they recommended a format be established for the contract. This provides a framework for the students and helps to organize their learning activity. It also helps insure that all critical information is included. Another key part of the introduction to self-directed learning is to explain how students will participate in the self-directed learning experience. Practical issues such as what the contract will look like, and whether the learner may alter the contract can be presented. The goals and objectives of the instructor, such as stimulating independent learning, providing opportunities for the learner to generate input into the learning experience, and recognizing individual needs are all important. In addition, discussion about the rationale for the use of this technique and its advantages are also a critical part of the discussion.

Hiemstra and Sisco (1990) also noted that institutional constraints must be considered in the use of self-directed learning. Specifically, they suggested that a careful analysis be made of the institution's policies regarding evaluation and grading. If, for example, the curriculum is specifically defined, or if the information is to be learned at the lower cognitive processing levels, the use of self-directed learning may not be appropriate. Finally, faculty contemplating use of self-directed learning must assess their own philosophy and feelings regarding grading, working with students, and their willingness to relinquish some degree of control over the educational process.

SELF-DIRECTED LEARNING AND TECHNOLOGY

The opportunities provided by "plugging into the information highway" will create changes in the interactions between teachers and learners, and between learners and subject matter. Foremost among these changes is the direct accessibility to information and increased autonomy of the learner. To best capitalize on this potential independence, alternative delivery strategies must be considered. The self-directed learning/contract learning model increases the potential for students to most effectively utilize the technology available.

In this scenario, the dynamics of the educational transaction changes. The teacher becomes a facilitator of learning rather than a dispenser of knowledge. The learners become empowered, and more responsible for their learning. Self-directed learning/contract learning provides two models for the effective implementation of technology in the higher education classroom.

REFERENCES

Grow, G. (1991) The staged-self directed learning mode. In H. B. Long (Ed.) Self-directed learning: consensus and conflict. Norman, OK: The Oklahoma Research Center for Continuing Professional and Higher Education.

Hiemstra, R. and Sisco, B. (1990) Individualizing instruction: making learning personal, empowering and successful. San Francisco: Jossey-Bass.

Knowles, M. S. (1975) Self-directed learning: A guide for learners and teachers. Chicago: Follett.

Knowles, M. K. (1991) Using learning contracts. San Francisco: Jossey-Bass.

Long, H. B. (1991) Self-directed learning: consensus and conflict. Norman, OK: The Oklahoma Research Center for Continuing Professional and Higher Education.

Shale, D. and Garrison, D. R. (1990) Introduction. In D. Shale and D.R. Garrison (Eds.) Education at a distance, p. 1-7. Malabar, FL: Krieger Publishing.

Schieman, E. (1990) Instructional development concerns. In D. Shale and D.R. Garrison (Eds.), Education at a distance, p 67-76. Malabar, FL: Krieger Publishing.

Schuttenberg, E. M. and Poppenhagen, B. W. (1980) Field experience in postsecondary education: a guidebook for action. Lanham, MD: University Press of America.

Williams, M. and Paprock, K. (1993) New dimensions for distance learning. In Proceedings of Quest for Quality, The National Research Conference in Human Resource Development, p. 247-250. College Station, Texas.

TEACHER IMMEDIACY BEHAVIORS AND STUDENT MOTIVATION IN THE DISTANCE LEARNING ENVIRONMENT

James Cunningham

and

Mary McLemore

Embry-Riddle Aeronautical University

INTRODUCTION

As parka-clad students gradually fill the seminar room, class is being called to order -- by a short-sleeved, sun soaked professor -- electronically, from two thousand miles away. Today, closed-circuit television networks using microwave links and telephone lines transport the ideas and images of teachers and learners in "real time" educational outreach programs. Distance learning technologies have evolved from simple telephone conferencing in

the seventies to multi-media, multi-site, interactive delivery systems. However, distancing tends to depersonalize.

Literature published in education and communication from 1983 to 1992 offered strong evidence that teacher behaviors relating to improved student motivation and learning outcomes equate to "teaching effectiveness" (Nussbaum, 1992). Carefully controlled empirical research showed significant correlations among "immediate" teaching behaviors (nonverbal behaviors which demonstrate liking for individuals using an approach/avoidance, like/dislike paradigm) and student attitudes toward classroom environments, assignment completion, and quality of instruction. In addition, students of immediate teachers not only perceived themselves as having learned more from these teachers than from non-immediate teachers, but also were more likely to subsequently enroll in other classes in the same subject.

Seven specific immediacy behaviors consistently produced positive student performance. They are: 1) smiling and praising student work; 2) maintaining sustained eye contact; 3)shifting the proximity of self to students; 4) encouraging students to talk -- soliciting viewpoints; 5) relaxing physically with an accompanying expressive voice; 6) using relevant humor and personal, positive disclosures; and 7) recognizing students by first names or accomplishments (McLemore and Cunningham, 1993).

Communication research validates the relational interpretations of teacher immediacy behaviors in conventional classrooms. But how has interpersonal

immediacy been manifested in distance learning environments?

Information regarding distance learning progressed from the 1970's technologically primitive telephone contacts between teacher and learner (Willen, 1981), to a zero-defects future on the global communication network. At present, examining distance education within a variety of spaces and times, researchers are analyzing problems and solutions. The most consistent problems relate to the communication concept of immediacy.

RESEARCH RESULTS:

DISTANCE LEARNING

Distance Learning and Immediacy

Research emphasizes the necessity for working more immediacy interactions into the multi-site learning equation (Houdek, 1990).

A 1978 sample of over 1000 students delineated types of problems generated by distance learning systems. The only one not associated with traditional learning, but the one noted most frequently, was that the learner had no one to turn to, no face-to-face presence on whom to rely for meanings and solutions (Murgatroyd, 1978).

While the communication research term "immediacy" is not used by the distance learning

researchers, their descriptions of the behaviors most needed and not yet attained are synonymous with definitions and examples of the immediacy construct.

In 1985, a theory of distance teaching included these criteria: for distance learning to support motivation and promote learning pleasure and effectiveness, it must be provided in a way that learners feel rapport with the providing institution, and participate in discussions and decisions. Conclusion: the program must include real and simulated communication to and from the learner (Holmberg, 1985).

Another recent evaluation at the University of Alaska (Houdek, 1990) emphasized the need for immediacy by proposing interaction with the students by means of more constant personal contact in the form of frequent teacher evaluations throughout the course. In a teacher's guide to managing distance education, Houdek described the ideal distance learning teacher as a person who possesses an ability to display enthusiasm for the teaching-learning process.

Facilitators

A recent study (Russell, 1991) called for the use of a facilitator to heighten the level of interaction. The data further reinforce the need for immediacy when they suggest that interacting factors are the best indicators of student achievement across sites and "the distance learning teacher should be able to reduce structure and to increase dialogue" (Russell, 1991).

Questioning the benefits of distance learning, Burleton (1984) emphasized contact with a course tutor as a principal source of positive results for the student.

Intensified Interaction

Featuring strong empirical methodology, Holmberg (1985) tested and confirmed this hypothesis: **the stronger the students' feelings that the supporting organization is interested in making the study matter personally relevant to them, the greater their personal involvement, the stronger their motivation, and the more effective the learning.**

It is also evident that some courses have more crucial requirements for approach-type contacts. Langford and Seaborne (1989) cited three different ethics courses which called for a blend of instruction and types of interactions easily recognizable as immediacy behaviors. The researchers examined strategies for producing interaction in Public Administration, Social Work, and Bio-Medical courses; each had a unique purpose in terms of the types of ethical decisions required by professionals in those fields.

Course goals -- to progressively develop the students' decision-making abilities -- required a high degree of active involvement between student and instructor. To achieve this, the strategy became closer interaction via a series of teleconferences featuring extensive dialogue with the teacher about the case

studies. The teacher then used these to monitor the progress made by each student in dealing with increasingly complicated ethical dilemmas. With some courses, interaction is the most important factor, and "we are far from understanding what kinds of techniques best fill specific interaction needs" (Langford and Seaborne, 1989).

Interaction Via Technology

One attempt at heightening interactive immediacy appeared in a Louisiana distance education program. Offering mathematics, science, and art courses, two evaluations were conducted (McElveen and Roberts 1992). The first evaluation measured student acceptance, student performance, and curriculum enhancement by surveying teachers. The second examined student perceptions of the system's effectiveness, the quality of the courses, and the teacher's delivery of the courses.

The courses' supportive technology included the personal computer, electronic penpad, audio convener, modem and a high resolution monitor. In place for seven years, the telelearning system is operated by a special software package. A telephone line augmented by a PC modem delivers vocal and digital components. The teacher converses with the classes vocally and on a bank of computer software images. The penpad works as an "electronic chalkboard" to transmit written information among the group of schools.

Approximately 20 students at four sites received instruction via computer three days per week and

worked independently the other two days. Each station had up to five microphones to provide voice contact between teacher and students.

In addition to the technical opportunities for interaction, each site provided a proctor. The findings illustrated that students were comfortable with the technology, and teachers were able to transmit their knowledge via the technology. However, lack of personal contact and visual feedback were named by both teachers and students as major drawbacks -- only relieved by the classroom proctor. These facilitators were acknowledged to be the most important element contributing to the success of the system and the most crucial determinant of student success or failure in the course. The authors recommended closer study of the proctor role because of its linchpin importance to the total structure.

Enhanced Immediacy

In 1988, Barker and Patrick examined 15 hours of video tapes to assess how effectively teachers delivered programs via satellite. Three teachers of introductory level courses in computer science, art and history, and sociology were observed over the TI-IN Interactive Satellite Network which employed one-way video and two-way audio transmissions. Assessment criteria included such immediacy interactions as praising, reviewing, statements of teacher expectations, numbers of student-initiated vs. teacher-initiated vocal exchanges, and the amount of wait time allowed for responses by students to teachers' questions. The

observers used a content analysis design to calculate how frequently these behaviors appeared.

Barker and Patrick (1988; 1989) concluded:

> * The important thing is that the instruction was indeed interactive -- students and teachers were in fact talking back and forth to each other via the medium.
>
> * The three teachers appeared to have good rapport with their students. Each displayed a genuine interest in their students' affairs -- academic and extra curricular ...
>
> * Two teachers recognized their students' voices and frequently called them by name.

Self-disclosure was among the immediacy behaviors Barker and Patrick noted. Teachers became "learners" -- one entered his computer programs from scratch, making corrections to show students that computer programs often don't run as planned. Another, the art teacher, displayed some roughed out work of her own to illustrate how to improve it.

The teachers made good use of the technology, but in addition made certain to use various immediacy behaviors to help them to interact. To prevent students from "hiding," two teachers "forced interaction" by

addressing students by name at specific sites to exchange questions; they were more successful in eliciting interchange than the teacher who made only general requests such as, "Be sure and call in now...."

Particularly relevant to the importance of immediacy behaviors is the observation that although students could see the TV teacher, the teacher was not able to see the students, which severely limited teacher sensitivity to student nonverbal cues.

Teacher as Producer

Partial solutions to limited interaction have surfaced. Moore and McLaughlin (1992) produced an interactive, two-way system which included one on-campus classroom located in a television studio plus one-to-three remote sites, all linked by video and audio. Each classroom -- remote or studio -- had monitors in front and rear for constant visual interaction. Three cameras were in action; one on the teacher, one on the class, and the third shooting down upon a stationary surface for graphics and "chalkboard" displays. At each site were VCR's and computer projection equipment used to send notes and messages.

At the studio, the teacher had production control and could switch the camera shots as required by the situation. A fax machine could send and receive assignments and messages; and microphones, including a wireless one for the instructor, were available to everyone for spontaneous responses and discussions.

Downsides of such courses are costs and the need for sophisticated classroom management; the

teacher becomes a television producer. Also, planning must always be at least one week ahead. Built-in delays include a week committed to designing the class, sending materials by courier, and delivering the instruction. Gone is the "teachable moment" -- add to that the difficulty of finding the skilled, immediate teacher who is also a TV professional.

The researchers concluded that at least part of such successes relates to how well the students learn to interact with one another. Further, they stated that because two-way visual interaction was not always possible, some important nonverbal clues in student messages were lost to the instructor.

Barker (1986) described the "real time" distance teacher as a studio manager and director of learning. Not only must the technology be reliable, under the teacher's management, it should not impose significant restrictions on the learner.

CONCLUSIONS

One strategy aimed at heightening feedback and thus bridging physical distances involves the deliberate application of immediacy enhancing behaviors. Smiling, praising, soliciting viewpoints, using first names, reinforcing spontaneity through relevant humor and self-disclosure -- humanize the distance classroom by communicating liking and respect transactionally. Knowing this, an immediacy-conscious aerospace professor on site at Cape Kennedy can reach out a

friendly hand to his students in Boston, Detroit, and Orlando as they focus together on technologies for the next century.

REFERENCES

Barker, K. (1986) Dilemmas at a distance. Assessment and Evaluation in Higher Education,. 11 (3) Autumn, 219-230.

Barker, B. and Patrick, K. (1989) Instruction via satellite television: an exploratory analysis of teacher effectiveness. Research in Rural Education, 5(3), 31-35.

Barker, B. and Patrick, K. (1988) Teacher effectiveness via interactive satellite; preliminary findings from observation of three teachers over the TIE-IN interactive satellite network. Paper presented at 80th Conference of National Rural Education Association, Bismark, ND, Sept., 2-20.

Burleton, B. (1984) Distance learning: who benefits? who pays? Journal of the Association for Programmed Learning, February, 40-45.

Holmberg, B. (1985) The feasibility of a theory of teaching for distance education and a proposed theory. Hagen, Germany: Fern Universitat.

Houdek, E. (1990) Managing distance education courses. The Guide Series in Continuing Education. Urbana-Champaign: University of Illinois, 1-45.

Langford, J. and Seaborne, K. (1989) Teaching professional ethics at a distance. Distance Education Services. Victoria: University of Victoria, BC, 2-10.

McElveen L. and Roberts, S. (1992) Telelearning, a second look: 1990-1991 and 1991-1992. Louisiana Evaluation Enterprise, Inc., Louisiana State University, 1-20.

McLemore, M. and Cunningham, J. (1993) Teacher immediacy behavior: student learning outcomes and evaluation. In J.A. Chambers (Ed.) Selected papers from the 4th national conference on college teaching and learning. Jacksonville, FL: Center for the Advancement of Teaching & Learning, Florida Community College at Jacksonville, 131-143.

Moore, C. and McLaughlin, J. (1992) Interactive two-way television: extending the classroom through technology. T.H.E. Journal, 19(7) 74-76.

Murgatroyd, S. (1978) Post-foundation students and the task of the counselor. Paper delivered at Welsh Research Group. Open University, Bucks, England, 1-4.

Nussbaum, J. (1992) Effective teacher behaviors. Communication Education, 41 April.

Russell, F. (1991) Receive-site facilitator and student performance in satellite-delivered instruction. Paper presented at Annual Convention of Association for Educational Communication and Technology, 1-20.

Willen, B. (1981) Distance education at swedish universities. A dissertation presented to Faculty of Social Sciences, Uppsala University, Sweden, 1-168.

FOUR TEACHING ROLES: ENRICHING GREAT TEACHERS

J'Anne Ellsworth

Northern Arizona University

INTRODUCTION

Improving the teaching of outstanding teachers is a challenge which is both stimulating and worthwhile. Most college instructors and professors who are interested in enhancing their teaching are already accomplished story tellers. They have a knack for getting ideas and information across to students. Content and erudition certainly are not at issue, unless perhaps it is keeping the ideas fresh and updated. Still, no matter how accomplished and skilled a teacher may be, there seems to be an innate desire to heighten effectiveness.

Each change the teacher initiates has a ripple effect. As the teacher changes, there are consequent changes in both content and student. This is a predictable occurrence, for teacher, student and content are dynamically and systematically meshed.

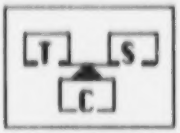
Bruner's (1966) work on discovery learning is a clear example of this principle. When the role of the student was altered, the quantity and type of learning

content changed as well. The teacher's role was also dramatically affected. The crucial finding here is that as we vary one, the other two vary as well. If we attempt to vary one without actively addressing the other two, we have less control, less success and unpredicted outcomes.

FOUR TEACHING ROLES

The role of teacher can be described along a continuum from teller and holder of knowledge to co-equal learner (Reinsmith, 1992). The models in Table 1 illustrate the interplay.

TABLE 1. Four Teaching Roles



Inducer-Persuader
Content driven, teacher led format with student assuming responsibility

Inquirer-Catalyst
Content acquired through discovery with emphasis on interrelationships

Dialogist
Discourse format with lifelong learner as focus. Mutual and interchanging leadership roles

Facilitator
Mutuality of content teacher & student with teacher as support

These four teacher roles introduce a continuum of changes, possibly hierarchical in nature initially, certainly interlocking with respect to changes in content and student roles. Once the roles have been developed, they can be used interchangeably to enhance and expand the variety and interplay in a course. They add a wonderful dimension to the teaching repertoire. They also aid the work of moving the student into a fully engaged life-long learner through the nature of the student roles. Finally, in teacher preparation settings, they expand the potential roles available to upcoming teachers, since the art and craft of teaching is best shared through modeling and through actual participation of future teachers in the changing student, teacher, content and evaluation formats.

An Example

Moving from the Lecturer to Inducer-Persuader may be the easiest place to begin. The teacher has the greatest burden of change and relinquishes control of the content and learning environment only as the student becomes more prepared to assume responsibility for learning. The process of change for the teacher typically involves:

1. Sharing more of the inner self, personal beliefs and the joy of teaching.

2. Describing personal feelings about content with breadth of spirit.

3. Building and deepening interpersonal relationships with students.

4. Establishing guidelines and student assists to deepen student responsibility.

5. Becoming more aware of the emotional impact of content.

6. Revising evaluation procedures to include mastery and student self report.

7. Developing playful and humorous responsiveness to content.

8. Awareness of, and respect for, the whole student, not just the mind (Reinsmith, 1992).

As the changes in teacher role proceed, it becomes clear that the student role is also involved in the transformation. As the teacher maintains the new role, students adjust their behaviors. The teacher can empower this change by clarifying options and describing alternatives and expectations. The expanded student role typically involves the following:

1. Responding positively and personally to the teacher, and thus the content.

2. Beginning to trust the teacher rather than trying to "psych" or gratify.

3. Initiating questions and volunteering insights.

4. Seeing learning as enjoyable and class as stimulating.

5. Becoming more aware of, and tolerant with, class members and their ideas.

6. Taking personal responsibility for class work and self assessment.

7. Appearing intrinsically motivated more frequently.

8. Seeming to be making connections beyond the surface knowledge.

There will be a variety of student responses to the change, no matter how clearly the role expectations are presented. Students who have a clear sense of the importance of learning feel a deeper personal commitment to the content.

There are students who have never valued learning. They may initially abuse or refuse to accept the expanded student role. With close monitoring and the enhanced teacher-student relationship, this dysfunctional pattern is usually short lived.

There are students, too, who have not established a sense of trust with teachers. Their "wait and see" approach typically lasts about six weeks, or until the first testing situation. The teacher's consistency and relationship allows the student to initiate a personal investment in learning and move

toward intrinsic motivation and interest in personal mastery of the subject.

Content also changes. Rigor and knowledge of the subject is an important part of the teacher expectations, but the emphasis shifts to application of content rather than acquisition of facts. Grading emphasis moves to a criterion-referenced testing process rather than a norm-referenced curve. Students become involved in documenting and demonstrating mastery rather than proving that they hold a competitive knowledge-based advantage over fellow students.

DISCUSSION AND CONCLUSIONS

The practice of college teacher as lecturer is deeply rooted in tradition. Common sense dictates that lecture, with associated readings and practice, is the most expeditious means for disseminating knowledge. So why attempt new teaching roles? From the teacher's point of view, these roles are very fulfilling. The pleasure that comes from teaching is increased dynamically with each step in the continuum. It is exhilarating to move from "Sage on the Stage" to genuine facilitator. It is mentally stimulating to choose the finest modality and leadership style for moving students into creative synthesis in concert with determining the content to be presented.

From the student perspective, each augmentation of student roles moves learning toward a more

personalized domain. Students who work through these roles become excited about learning, intrinsically motivated and affectively tied to reflection, thinking, and questing. The one certain method for approaching the dream of creating life-long learners comes from the empowerment of students as co-authors of learning.

As the interaction develops in the course of learning and teaching, content is carried further. Content is no longer trivialized as a search for facts. The course work is no longer categorized as a containable set of disjointed facts. Instead, the very process of learning and thinking is celebrated and practiced. The student and teacher seek together to advance understanding. Collegiality moves into the domain of all participants and strengths are shared and valued, rather than feared or suppressed.

True, a great deal of work goes into any change. Moving into new teaching roles and educational leadership stances will cause some anxiety, may result in a few pitfalls,and will definitely unnerve students. But the new vistas are worth the climb!

REFERENCES

Bruner, J. (1966) Toward a theory of instruction. New York: Norton.

Reinsmith, W. A. (1992) Archetypal forms in teaching: a continuum. New York: Greenwood Press.

CHANGING THE INSTRUCTIONAL ENVIRONMENT TO ENHANCE LEARNING

Sandra L. Gilchrist

New College of University of South Florida

INTRODUCTION

There has been no shortage of suggestions on enhanced learning techniques over the past decade (American Association for the Advancement of Science, 1984; 1989; 1990). The Wingspread Group on Higher Education recently released a comprehensive, highly critical report on shortcomings of higher education along with recommendations for change (Magner, 1993). Common threads throughout such reports are that technological innovations must be more fully integrated into learning environments without removing the teacher from the overall experience, hands-on experience is necessary, and writing is a vital tool (see McGovern and Hogshead, 1990 for a discussion of writing).

Extremes exist currently from fully technological classrooms where students work with interactive computers and videos with a professor/supervisor to oversee progress to a faculty-centered classroom with little in the way of modern technological tools or

teaching innovation. Neither is a model for future education. **What is clear is that faculty, students, and administrators must all take active roles in changing the learning environment.**

RESEARCH FINDINGS

Bonwell and Eison (1991) provided a comprehensive formula for creating a supportive learning atmosphere. They only touched briefly on the role of technological innovation in achieving such a setting. The focus is more on people, examining ideas of why faculty are resistant to change in general and why there is specific resistance to active learning techniques from students, faculty and administrators.

It should be noted at the outset that there are few incentives at research universities for faculty to address issues of undergraduate education. More rewards are given for such efforts at liberal arts and community colleges. Thus, resistance levels vary as do barriers. In this discussion, barriers to use of technology in creating an active learning environment are viewed in the contexts of support as well as the amount of risk in embracing change.

Among the most formidable barriers for faculty is lack of support for integrating change into the classroom. Active learning techniques incorporating technology rely on student involvement in the learning experience in a time when library resources are dwindling and when budgets have not kept pace with inflation. However,

initial changes in the learning environment can be made with little cost. Much of the up front investment is in retraining personnel, altering hiring practices and creating incentives for successful grant writing related to education.

Use of technology leads to decentralization. Faculty more comfortable with lecture style teaching are not prepared to embrace change which involves less control. According to Bonwell and Eison (1991), when instructors were asked to allow students time in class for active learning activities such as writing, role playing, and computer simulation, faculty complained that material necessary to complete a class could not be finished and that there was a feeling that there was a lack of control.

Reluctance to relinquish control is also observed in testing methods. Time honored traditions such as comprehensive final examinations may actually be counterproductive, yet they are still used extensively (Schilling & Schilling, 1994). Notions such as group testing or projects in lieu of testing are received with skepticism. Faculty and students are not taught that it is "okay" to disagree and that such arguments occur naturally in academia (Reif-Lehrer, 1993).

The above is especially true in what are considered more "content oriented" classes such as biology and physics. In biology, core curricula have changed little since the 1967 Commission on Undergraduate Education in Biological Sciences report issued recommendations on content (Carter, et al., 1990). In physics, computer models illustrate principles with little explanation of process (Taylor, 1988).

The literature contains many references to problems associated with content and class size (Cowan, 1984; Illman, 1993; Ligon, 1993), with use of computer simulations and group activities in large, content driven classes (Hicks and Laue, 1989), as well as how to organize research and research education at different levels (Conrad, et al., 1993; Maher, et al. 1994).

Innovations which allow change include contract systems with students in which fulfillment of a series of requirements guarantees a student a certain evaluation. These have been used successfully, with both students and faculty noting high levels of satisfaction. However, there are time commitments and risks to such approaches.

It is in conjunction with these types of programs that techniques such as computer simulation and interactive video have been used effectively. To date, there has been little effort to retrain professors in how to use active learning techniques through application of technology. Information on activities with high levels of success may occur in journals not commonly accessed by university faculty (e.g., Council on Undergraduate Research Quarterly, College Teacher, and American Biology Teacher).

It must be made clear that retention, promotion, and salaries are related to cooperation in implementing an enhanced teaching program. Evaluation of credentials at hiring should also include criteria such as teaching style and incorporation of technology into courses. Although uncommon, guest lectures/teaching in a class in addition to the "canned" presentation of research should be required of all prospective faculty.

Risks are not always rewarded through student evaluation or through administrative support. Administrators, colleagues, and students need to be educated about how much time and energy are required to incorporate technology and teaching innovation into the classroom, especially if it is being done on a shoestring budget. It is also critical to acknowledge that not every effort will be successful. There must be willingness to allow experimentation. However, students should be notified in advance if a course is experimental.

SUGGESTIONS FOR CHANGE

1. Use models generated at small colleges to begin experiments in larger class settings.

2. Make sure that support structures are in place before embarking on the use of technology in the classroom. This includes faculty and staff training.

3. Foster an atmosphere of communication. Faculty feedback on successful and unsuccessful efforts should allow modification of technique. Accept the notion that some faculty will be more comfortable using more traditional teaching formats.

4. Use teaching diaries to record efforts. These can lead to more objective evaluations of work.

5. Conduct grant writing workshops and promote cooperative efforts for funding of educational innovation. Several agencies now have funds available for support of undergraduate education.

REFERENCES

American Association for the Advancement of Science (1989) Curriculum in the year 2000. Washington, D.C.: AAAS

American Association for the Advancement of Science (1984) Involvement in learning. Washington, D.C.: AAAS

American Association for the Advancement of Science (1990) Report on liberal education and the sciences. Washington, D.C.: AAAS

Bonwell, C. and Eison, J. (1991) Active learning: creating excitement in the classroom, Report 1. Washington, D.C.: ASHE-ERIC Higher Education Reports

Carter, J., Heppner, F., Saigo, R., Twitty, G. and Walker, D. (1990) The state of the biology major. BioScience, 40(9), 678-683.

Conrad, C., Neuman, A., Haworth, J. and Scott, P. editors. (1993) Qualitative research in higher education: experiencing alternative perspective and approaches. Washington, D.C. ASHE Reader.

Cowan, J. (1984) The responsive lecture: a means of supplementing resource-based instruction. Educational Technology, December, 18-21.

Hicks, R. and Laue, H. (1989) A computer-assisted approach to learning physics. American Journal of Physics 57(9), 807-811.

Illman, D. (1993) Large, small colleges discuss groundwork for hands-on learning. Chemical and Engineering News,. February 22, 29.

Ligon, S. (1993) Investigation in large enrollment labs. Strategies for Success Newsletter, 13, 6-7.

Magner, D. (1993) A biting assessment: a report chides colleges for neglecting undergraduate education. Chronicle of Higher Education, December 8, A26.

Maher, H., Shuster, R., Swearingen, J. and Honke, J. (1994) Undergraduate involvement in the development of an environmental geology laboratory. Council on Undergraduate Research Quarterly, 14(3), 131-133.

McGovern, T. and Hogshead, D. (1990) Learning about writing, thinking about teaching. Teaching of Psychology, 17(1), 5-10.

Reif-Lehrer, L. (1993) Effective teaching is a skill that researchers can learn. The Scientist, June, 20-21.

Schilling, K. and Schilling, K. M. (1994) Final exams discourage true learning. Chronicle of Higher Education, February 2, A52.

Taylor, E. (1988) Learning from computers about physics teaching. American Journal of Physics, 56(11), 975-980.

MATHEMATICAL BIOLOGY – A COURSE USING COMPUTER-AIDED INSTRUCTION

Thomas J. Herbert

University of Miami

INTRODUCTION

The disciplines of science rely upon both language and mathematics as means of description. Some disciplines, such as physics, rely more on mathematics than other disciplines such as biology. Nevertheless, mathematics is an important "language" of all fields of science. In biology, mathematics is necessary for adequate description of processes ranging from enzyme kinetics in biochemistry to competition in population biology and ecology. This paper will describe problems of integration of mathematics into the biology curriculum and the solutions being developed at the University of Miami.

MATHEMATICS IN THE BIOLOGY CURRICULUM

Biology majors following the B.S. degree program in the Department of Biology at the University of Miami take a year of calculus and either a computer programming or statistics course. Nevertheless, most students who reach junior/senior biology courses are deficient in the ability to formulate and solve simple word problems or manipulate fundamental equations. For example, in a cell and molecular biology course, students have difficulty in solving the Michaelis-Menten equation, $V\backslash V_{max} = S\backslash(1+S)\}$, for substrate concentration, S, given $V\backslash V_{max}$. Many do not understand logarithms and most cannot explain the meaning of an exponential growth rate or time constant.

In an attempt to solve these problems, a new course in Biophysics was introduced 13 years ago, designed for junior and senior students in biology. The principal goal of this course is to help students to develop problem solving methods in biological sciences and to use mathematics to do useful calculations, integrating key aspects of the mathematics, physics, chemistry, and biology which the students have learned earlier in their studies.

The present Biophysics course has proved to give too little practice in using basic mathematical techniques and comes too late in the students' career to effectively remedy fundamental problems in mathematical literacy. It emphasizes an integrative approach to improve

quantitative skills of students about to finish their undergraduate studies. Most students, particularly those at earlier stages of their program, benefit most from a more synthetic approach which is designed to teach basic problem solving skills and use these skills in a discussion of contemporary themes of mathematics in biology.

One of the deficiencies of the present Biophysics course is that students cannot interact with the material. They are presented with a static series of notes and graphs which they cannot actively change. Understanding of mathematics requires constant repetition, feedback and timely reinforcement. The application of mathematics to biological science often requires study of complex mathematical problems. It is impossible to consider these types of problems or give the constant feedback which the students need without the development of a modern computer classroom/laboratory.

Computer-aided instruction, using state of the art methods, permits rapid repetition, constant feedback, and timely reinforcement as the student tries different options and methods. It also allows the instructor to emphasize the study of relevant, complex, and realistic mathematical scenarios.

The primary goal of a new approach to integrating mathematics into the biology curriculum should be to teach students to think mathematically and to be able to solve problems within the context of the biological sciences. A key point in realizing this goal is that mathematical understanding and problem solving ability are different from the skill of mathematical computation.

Students of biology should be able to understand and apply concepts in mathematics such as the effect of randomness on experimental design and analysis, the implications of size and scaling laws, the advantages and pitfalls associated with modeling of biological systems and the implications of complex systems for biological function. A course in Mathematical Biology should teach students to formulate the description of quantitative problems in terms of mathematical operations; the methods of performing those operations are secondary! The student should be freed from tedious, specialized, and sometimes impossible calculations by use of graphical methods of presentation and solution for complex problems.

In an essay in The New York Times, John Allen Paulos (1991) supported the position that mathematics is not computation. "Imagine that throughout the course of one's education all one ever did in English class was diagram sentences. It wouldn't be surprising if one didn't acquire a terribly keen appreciation of literature." (Paulos, 1991). It is the goal of Mathematical Biology to free students from most of the diagraming and give them the tools to think mathematically and do useful problems.

Thomas J. Herbert 47

A COURSE IN

MATHEMATICAL BIOLOGY

Mathematical Biology is organized into three stages: 1) fundamental concepts in Biomathematics; 2) complex processes in Biology; and 3) student projects. Each of the first two stages of the course is organized in weekly topic areas with an integrated series of three lecture/demonstration sections and one, three hour laboratory. The lecture periods consist of a conventional lecture format integrated with computer demonstrations. The course ends with pairs of students devoting full time for several weeks to individual projects.

Mathematical Biology emphasizes basic concepts in mathematics and applies them to interesting and relevant biological problems, integrating with the course content of the introductory courses taken by biology majors. One of the early units extends over two weeks and discusses the exponential function, one of the most important functions in biology. Students are not just presented with the definition of an exponential, they actively explore its properties and use in biological science. Both exponential growth and decay are discussed. Students learn to take word problems and translate them into equations and numbers.

One problem which illustrates the above is the following:

"Suppose that the membrane potential is -50 mv at a synapse and decays exponentially towards -60 mv at a

point far distant from the synapse. If the exponential space constant is 1 mm., what is the membrane potential 0.5 mm from the synapse? At 2 mm, 1 cm, 10 cm?"

Although this is an elementary problem and requires no use of calculus, most biological science students cannot solve it. Students in Mathematical Biology learn to do so by practice and repetition. The exponential is studied exhaustively using examples which include kidney dialysis, simple enzyme kinetics, and population growth.

Another unit in the early part of the course emphasizes the application of simple linear equations and graphing techniques to biology -- examples include competition in population biology and enzyme kinetics. Random processes are also stressed, including simple concepts of probability applied to genetics and measurement. The idea that errors of measurement are often related to the square root of a measure quantity -- the "square root of N law" -- is emphasized.

Much of the first stage of the course centers around the repetitive application of a very few basic mathematical ideas to simple biological problems to which the students have already been exposed. The second stage of the course builds upon this familiarity of basic ideas and presents the students with examples of complex phenomena which are fundamentally based upon simple mathematical constructs -- the shape of spiral mollusks, chaos and its relationship to spatial and dynamic temporal patterns.

The final stage of the course allows the students to build their own simple models by doing projects under

the guidance of the instructor. The students must build the equations for a biological process themselves or adapt existing equations. They gain confidence by producing something new and unique and presenting the results to the rest of the class.

The laboratory sessions consist of exercises which emphasize interactive problem-solving. For laboratory, students are organized into teams of 2-3 individuals who work on problems together, and form a group for a three-hour laboratory session, scheduled separately from the three lecture periods per week. For most laboratory sessions, the student is presented with a pre-programmed notebook on the workstation. This program presents simulations and a series of laboratory exercises in which the student is required to analyze simulation data, plot results, and solve symbolically or numerically.

Modern workstation computing using a mathematical toolbox program permits the above sessions to be true laboratory exercises. Data are simulated on the computer and flow into a computer aided analysis system -- the experiment, the laboratory notebook, the calculator and worksheets, and final report are integrated into one system.

An essential need for this course was a mathematical toolbox which could rapidly evaluate complex expressions using prepackaged mathematical operations. This need was met by the computer program Mathematica (Wolfram, 1991), installed on a system of workstation computers. This program implements an interactive textbook which permits repetition, feedback, and timely reinforcement and provides a flexible,

responsive problem solving environment with graphical, image, and sound input and output capabilities.

Mathematica is an interactive, interpretative language imbedded in a Notebook structure. A Notebook combines narrative text with graphical and numerical results of computations and the instructions (program) required to recreate the results. The student can change numbers or the structure of the equation and see the output change in the Notebook.

Mathematica includes 843 built-in mathematical functions and includes the ability to do Fourier analysis, solve ordinary differential equations and do symbolic and numerical integration. Usually, the instructor can program exercises with just a few lines of instructions and the student can change the program just as easily.

Since this is an interpretive language, Notebook programs run somewhat slower than a standalone, complied program and require more powerful hardware. But, the instructor does not have to construct the program interface and graphics support or programs for calculation of complex mathematical functions.

CONCLUSIONS

Mathematica has been used at several universities as the platform for an interactive textbook and laboratory in undergraduate instruction. California State University, Los Angeles, has received a grant from the NSF for a proposal entitled "The Interactive Electronic Blackboard for Natural Science and Mathematics

Education" in which "NeXTstation computers will be used as interactive electronic blackboards --- students will use more of their senses in this powerful, intuitive approach" (NeXT on Campus, 1991).

At the University of Iowa, K. D. Stroyan (1993) has developed an introductory calculus course based upon the use of Mathematica. He has prepared a text and a set of Mathematica Notebooks for this course which use the concepts of an electronic textbook and mathematical project Notebooks on epidemiology, predator-prey interactions, and enzyme-mediated reactions.

The course in Mathematical Biology builds upon these projects and provides a direct link between instruction in mathematics and in biology, integrating both disciplines and helping the student to learn science rather than just course subjects in a usually fragmented curriculum.

REFERENCES

NeXT on campus. (1991) Fall, 12 - 15.

Paulos, J. A. (1991) Math moron myths. New York Times, (OP-ED), April 24.

Stroyan, K. D. (1993) Calculus using mathematica. New York: Academic Press

Wolfram, S. (1991) Mathematica - a system for doing mathematics by computer. Redwood City, CA: Addison-Wesley.

TEACHING AN INTRODUCTORY PROGRAMMING COURSE USING ADVANCE ORGANIZERS AS LEARNING AIDS

Larry M. Holt

Rollins College Brevard Campus

INTRODUCTION

Meaningful learning takes place when the learner connects new material with knowledge that already exists in memory (Bransford, 1979). Logic dictates, therefore, that students learn by associating new material with prior knowledge and previous experiences.

But what happens when the new material is so new and different that the learner has no background "database" within which the new material can be assimilated? Students who are enrolled in an introductory computer programming course frequently find themselves in this situation. The new material, which consists of such items as language syntax rules, programming constructs, and problem decomposition techniques, cannot be easily related to prior knowledge or experience. This dilemma poses a significant learning

barrier which leads to reduced learning and an overall frustration with computer science (or related) courses.

Historical Perspective

Research conducted in the 1960's provide both theoretical and empirical evidence that advance organizers enhance an individual's ability to learn from textual materials. A typical example of such studies has been described by Ausubel (1960). Prior to giving 120 college students a 2500-word text on metallurgy, researchers gave half of the students a 500-word advance organizer that presented a framework and various abstract principles concerning the upcoming information. The other half of the students were given a 500-word historical passage. A post-test determining basic comprehension of the 2500-word text indicated that the advance organizer group performed significantly better.

Ausubel defined advance organizers as "appropriately relevant and inclusive materials...introduced in advance of learning" whose function was "to provide ideational scaffolding for the stable incorporation and retention of the more detailed and differentiated material that follows" (Ausubel, 1960, p. 148).

Mayer (1981) reported on four advance organizer related studies which included a total of 180 subjects. He found substantial evidence that encoding and use of new technical information by (computer) novices was enhanced by the incorporation of advance organizers.

Mayer's conclusions are also in concert with the view presented by Soloway (1986). He indicated that

computer novices have difficulty solving programming problems because they have no mental library of "stereotypical solutions to problems as well as strategies for coordinating and composing them" (Soloway, 1986, p. 850). In other words, novices have no framework or reference points from which to determine a viable programming solution to a problem. Part of the role of an effective advance organizer in teaching computer programming is to provide scaffolding, vision, and insight so that novices can quickly and correctly begin constructing their own mental libraries.

DESCRIPTION OF THE STUDY

This study took place over a 20-month period and involved four separate semester long introductory computer programming classes. Rollins College Brevard Campus, is a liberal arts institution with approximately 500 students (40% males, 60% females). Most students at this college are categorized as nontraditional students -- that is, working adults, having completed high school at least five years ago, attending night school, and living at home (rather than on campus). The introductory computer programming course content and objectives are fashioned after Computer Science I (CS1) as specified by the Association for Computing Machinery (Gibbs & Tucker, 1986). The language of instruction in the course was Turbo Pascal 7.0.

The classes were designated as either a treatment or control group. The treatment group received and read

a 3 to 6 page analogy-based advance organizer prior to the class lecture. The control group received an equivalent length computer article chosen at random from various publications.

The advance organizers were produced by examining the lecture material and creating an analogy-based story whose concepts closely paralleled the more technical information presented in the lecture. For example, when covering the Pascal "if" statement, the advance organizer provided a foundation addressing the decision-making process of a computer program by comparing the process to that performed by a human. In this case, an example referring to a familiar situation, that of driving in traffic, was used to help the student establish the logical relationship between making decisions in real life and making decisions in a computer program.

Students in this study completed the same exams (3 @ 100 points each) and programming projects (3 @ 50 points each). Course achievement was determined by scores received on those instruments. Course presentation utilized the same schedule of topics, overhead transparencies, and text book.

The design of this study addressed the numerous validity threats which can be found in a quasi-experimental sample of convenience design. For example, to reduce instructor bias, all exams and programming projects were graded by a team of student assistants using a standardized scoring sheet. Additionally, students completed a Pascal pretest on the first night of the class. Scores on the pretest were used as a covariate in the data

analysis to partial out initial differences in programming ability.

FINDINGS

During this study, a total of 71 students (29 females and 42 males) enrolled and completed the experimental course. Forty-four of these students were enrolled in the treatment group and the remaining 27 were enrolled in the control group. Table 1 summarizes by group and gender the results obtained in this study.

TABLE 1. Summary of CS1 Pascal Pretest and Course Achievement

	Pascal Pretest		Course Achievement	
	Mean	Std Dev	Mean	Std Dev
Control (n=27)	6.6	2.0	331.2	43.1
Female (n=11)	7.3	2.0	344.1	27.7
Male (n=16)	6.2	1.8	322.4	49.1
Treatment (n=44)	8.7	3.7	375.1	39.4
Female (n=18)	8.3	3.3	370.6	31.1
Male (n=26)	8.9	3.9	378.3	44.0

A multiple regression correlation analysis of the data in Table 1 indicated the treatment group had significantly higher course achievement. The effect size (f^2) associated with instruction method was computed as .27 and, using Cohen's (1983) formula for computing power (model 1 error approach), indicates the power associated with these findings being nearly .99.

CONCLUSIONS AND RECOMMENDATIONS

The results obtained in this study lend support for the hypothesis that course achievement is increased by incorporation of advance organizers into the course presentation. The 13.2% increase in performance over the control group is significant in terms of practical and educational considerations. In essence, this study took an existing course (its lecture material, programming projects, and exams) and simply added an advance organizer handout, which students read at the beginning of each class.

The findings provide statistical support for the concept that educators who teach a course similar to CS1 may expect to obtain higher course achievement from their students if advance organizers are incorporated into the course presentation. However, care should be taken in interpreting the data widely due to the small sample size and the specific population involved. With the above limitations, however, it should be noted that advance organizers can be tailored to specific topics addressed in each lecture. The existing class material and presentation

do not have to be altered. All that is required is that an adequate amount of time be set aside at the beginning of the class for the students to read the advance organizers. Obtaining higher course achievement coupled with maintaining existing course structure should be an appealing combination to Computer Science educators.

REFERENCES

Ausubel, D. P. (1960) The use of advance organizers in learning and retention of meaningful material. Journal of Educational Psychology, 51, 267-272.

Bransford, J. D. (1979) Human cognition. Monterey, CA: Wadsworth.

Cohen, J. and Cohen, P. (1983) Applied multiple regression/correlation analysis for the behavioral sciences (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

Gibbs, N. E. and Tucker, A. B. (1986) A model curriculum for a liberal arts degree in computer science. Communications of the ACM, 29(3), 202-210.

Mayer, R. E. (1981) The psychology of how novices learn computer programming. Computing Surveys, 13(1), 121-141.

Selected Conference Papers 60

Soloway, E. (1986) Learning to program = learning to construct mechanisms and explanations. Communications of the ACM, 29(9), 850-858.

ENHANCING LEARNING THROUGH TEAM WORK IN INFORMATION PROCESSING

Shirley A. Hudson

Southern Illinois University at Carbondale

INTRODUCTION

This two year study addressed innovative methods for using computers to teach team work skills in an information processing project. Earlier, Hudson (1993) stated, "Students normally are not provided sufficient opportunity to experience team work" (Hudson, 1993, p. 29). This paper describes how team concepts were incorporated to include not only multiple programming and problem solving skills, but also team work skills in classroom settings.

Why are team work skills needed? They are needed to help students prepare for work. Many organizations are down sizing and incorporating team work with fewer personnel. Boudette (1990) stated that "It can help flatten organizations by requiring less direct supervision by middle-level managers and allowing managers to lead greater numbers of people" (Boudette, 1990, p. 65). Students need team work skills for entry-level positions.

According to Busse (1992), "Business executives reason that if they can fill their organization with bright and able entry-level workers, there won't be much need for layers of middle management" (Busse, 1992, p. 24).

Students are given the opportunity to apply concepts learned in previous courses to analyze and design projects. The Information Processing Project, a six-credit hour course, was changed to provide students with opportunities to enhance learning and team skills. This course imparts theory essential to entry-level positions in business.

BACKGROUND INFORMATION

A survey was taken of 100 businesses relating to employment of persons in technological positions -- 62 responded. The survey was conducted to determine essential entry-level skills. It revealed that COBOL skills, as well as problem solving skills, were needed.

Respondents were asked about programming languages used in their mainframe environments. The most frequent responses to "What computer languages are used in your organization?" were COBOL (34.4%), and Assembler (17.6%). In microcomputer environments COBOL was among the top three languages (14.4%). The survey also showed problem solving skills (15.6%) as the most important to entry-level positions. College degree (14.2%) and communications skills (13.2%) were second and third.

Various approaches to teaching COBOL have been tried in colleges and universities. Brant (1992), Project Manager at Exxon Company stated, "On-the-job training isn't enough to give workers the skills they'll need to function in the new environment. It is essential that the training begin as soon as possible in the education process" (Brant, 1992, p. 25). Team skills are essential and must be incorporated in educational settings.

THE REDESIGNED COURSE

During Spring, 1993, the instructor assigned team members, and teams elected leaders, alternate leaders, consultants, loggers, and researchers. Team leadership varied, and the instructor observed how some leaders were made nervous by responsibility. It was soon learned that team leaders and team members must be convinced they have investments in the projects. Students were careful to select persons with strong programming experience. It was explained that every student had to be involved in all aspects of the project.

Students must use many skills learned in one and one-half years of study. They must apply concepts learned to identify a problem, and design and develop COBOL solutions. System design techniques are used to analyze problems. The total project is separated into five phases with deadline dates used to guide progress during the semester. Each phase of the project entailed separate, but related computer runs providing experience in

multiple programming using COBOL. Team interactions were used to provide students with experience working not only with their team members, but also with other teams. Students were instructed to solve all problems within their teams. The instructor helped only if teams could not solve their own problems.

Student teams analyzed problems, developed system proposals, and designed and implemented systems using COBOL. It is said there are two types of workers: those who work, and those who make work for others. According to Matanic (1988), "Ideally, a team player should be a well-balanced, responsible individual fully cognizant of his or her professional role and status" (Matanic, 1988, p. 20). During the semester, students were reminded that they were team players, all members should be involved in decisions, and they must conduct themselves professionally.

Each phase assignment was worth forty points in the grade formula. Phases turned in on due dates received extra points. The instructor monitored team progress by reviewing programs completed in each phase. If a team member's assignment had to be done by another team member, the student lost points on that phase assignment. An outline sequence of how final project materials were to be placed in a binder was also provided. Final projects were worth 500 points, and team members had to sign a sign-off sheet giving their approval for final grading. Students used prepared instruments to evaluate their teammates. These were completed at the end of the semester and given to the instructor.

Major conflicts came just before midterm in the semester. Some team members began to argue, and problems occurred. Some students wanted to do their best to earn high grades and expand their skills, while some students were content to "get by". This upset some team members and resulted in some heated team meetings. These teams were called in by the instructor. Team members were asked to express their views of what the problems were. After each team member expressed his/her views and concerns, the instructor asked each member to provide positive solutions. Each team solved its own problems.

Although students had been in other courses with team members, they realized how much they did not know about each other. Because of personalities, adjustments had to be made so projects could be completed. The instructor stressed open communication, which helped to keep students motivated.

Allcorn (1985) stated, "...getting the most in terms of productivity from groups requires that managers make the best of each group's interpersonal dynamics as well as each member's strengths, weaknesses, behavioral tendencies, and fears" (Allcorn, 1985, p. 52). Teams were encouraged to build on each others strengths, not weaknesses. Open group discussions and team meetings were held by the instructor. Sometimes these discussions and meetings were done weekly. Hearing problems encountered by other teams helped students to see their team problems in a different light.

Students gave presentations regarding their solutions while being video taped. During presentations,

two guests, an accounting professor and a Chicago bank programmer, were present to provide students with feedback. Both gave the students suggestions and recommendations about their presentations. Other business persons were guest speakers during the semester. Their input was helpful because of its real world base.

FINDINGS

Twenty-one former students from Spring 1992 and 34 students from Spring 1993 were surveyed, with an 88% and 97% return respectively.

Students were asked, "Were the objectives for the team-oriented project met?"

1992 students responded: 83% Yes and 17% No.
1993 students responded: 91% Yes and 9% No.

When asked, "Do you feel a team-oriented project should continue to be a part of the Information Processing Project (CIP 213) course?"

1992 students responded: 94% Yes and 6% No.
1993 students responded: 100% Yes.

It was interesting to note that four 1992 students failed and only one 1993 student failed (see Table 1).

TABLE 1. Student Survey

	1992		1993	
	YES	NO	YES	NO
Team-oriented objectives met?	83%	17%	91%	9%
Continue team-oriented projects?	94%	6%	100%	

The 1992 students were asked, "If you had it to do over, would you still want to choose your team members?"
They responded: 61% Yes and 39% No.

1993 students were asked "If you had it to do over, would you rather choose your team members?"

They responded: 67% Yes and 33% No.

The class of 1992 chose their team members and the instructor assigned team members in 1993.

Students were asked, "Do you feel the grading was designed in a way to ensure each student would receive the grade he/she earned?"

1992 students responded: 72% Yes and 28% No.
1993 students responded: 79% Yes and 21% No.

Students were asked to list suggestions to improve the course. Some suggestions from the class of '92 were: 1) individual teams should evaluate their members after each phase; 2) excellent learning experience, but some teams were hindered by members not dedicated to the project; 3) more meetings with individual students; 4) teams grouped by the instructor to ensure diversity.

The class of '93 offered these suggestions: 1) there should be no team leader, because some people do not handle authority; 2) teams should be balanced (male/female); 3) team members should understand that team work comes first, and they must put personal problems aside.

CONCLUSIONS AND RECOMMENDATIONS

Inter-group processing and sharing of ideas was very beneficial. The determination of the students to complete projects with or without some team members was noted by the instructor. The grading formula required all team members to do their part. This served to motivate some students when they felt hampered by members who were not committed to the project. The instructor reminded all students that they could not pass by letting other team members do all the work.

Students should be involved in all aspects of the project. Team members should evaluate each other after each phase. Phase evaluation can be used to check members' participation during the semester. Instructors

should also review team logs during the semester to keep up with team progress.

Learning can be enhanced and provide a positive learning experience for both the student and instructor. Changes are being made in Spring '94 to incorporate some of the suggestions made by former students. Continued research and feedback is needed to ensure positive learning when using team concepts in the classroom.

REFERENCES

Allcorn, S. (1985) What makes a group tick. Personnel, Sept.,62, 52-58.

Boudette, N. E. (1990) Give me a "T!" an "E"...In the '90s the well-oiled company will know how to spell T-E-A-M. Industry Week, Jan. 8, 62-63 & 65.

Brant, C. (1992). Exxon wants team players. Vocational Education Journal, 67(5), 25.

Busse, R. (1992). The new basics. Vocational Educational Journal, 67(5), 24-25 & 47.

Hudson, S. A. (1993). A practical approach team work in information processing project. Myrtle Beach, SC: Instructional Uses Conference Proceedings Abstracts, Computers On Campus National Conference, p. 29.

Matanic, B. (1988) How to be an effective team member. The Secretary, May, 20-22.

Note: The author is continuing her research in team concepts in classroom settings, and would like to network and share ideas with other instructors. The author would also like to thank her students for their participation and significant contributions to this study.

DESIGNING MULTI-SITE INTERACTIVE VIDEO SEMINARS: EXPERIMENTAL INSTRUCTIONAL MODELS DEMONSTRATED

Otolorin Jones

and

David L. Elliott

Empire State College

State University of New York

INTRODUCTION

In Daniel Bell's (1976) forecast of the coming of post industrial society, he did not fully prepare readers for the massive technological changes now revealing themselves as the second millennium draws rapidly to a close. Virtual reality, cyberspace, interactive video telephone conferencing -- the dreams of the 1950s are now in practice and are transforming both the workplace and

education in ways more fundamental than even the science seers of the 50s and social futurists of the 70s could fully imagine. This paper reports on one project in which business, adult education, and technology have converged: the Empire State College and NYNEX joint pilot project delivering credit-bearing college courses to NYNEX employees using videoconferencing technology.

Videoconferencing utilizes computer intervention to transform audio and video signals into an electronic form that can be transmitted over telephone lines. Such a technology offers challenges and opportunities to bridge distances and serve learners who are place bound, in remote locations, or whose schedule does not allow for classroom attendance. According to Florini (1990) this and other related technologies, are transforming education.

One of the hallmarks of adult education, the practice of andragogy as opposed to pedagogy, is learner self-direction. Pratt (1988) contended, however, that adult learning is not always synonymous with self direction, that in fact, self direction and dependency (on the teacher and other adult learners) may exist within certain context bound situations.

After examining pertinent teacher, learner, and situational variables, Pratt concluded that "self direction is a situational attribute of learners, not a general trait of adulthood...and a learner's dependency on a teacher equally should be temporary and situational, capable of being changed through an appropriate mix of direction and support" (Pratt, 1988, pps. 161-62).

Within the above context, the present paper addresses situational variables associated with

videoconferencing. It uses as a case illustration the Empire State College/NYNEX project in relation to selected adult learning methods and techniques.

THE SETTING: ANTECEDENT SITUATIONAL VARIABLES

Administration and Organization

Empire State College, in collaboration with NYNEX, offered two interactive videoconference courses in the fall of 1993, which were repeated in the spring of 1994. These courses were offered to NYNEX employees at different locations each term. The courses were "Marketing Principles," an existing Empire State course based on the learning contract/distance education model, and "Faces of Culture," a video-based introduction to cultural anthropology, produced by Coast Telecourses, Coast Community College. "Faces of Culture" videos were viewed by students before each videoconference session.

Videoconference sessions met one evening every other week between 6:00 and 8:00 p.m. The frequency and length of sessions was arbitrarily decided. The time was decided by NYNEX based upon videoconference network availability and presumed convenience for employees, who attended on their own time. There were seven videoconference sessions for each course.

All students were NYNEX employees and the videoconference took place on company property. Locations were selected by NYNEX. Both terms, instructors were located in Albany (nearest site to Empire State) and the site was open to students as well. For the first offering of one course, "Faces of Culture", no students were present at the Albany site. The three additional sites for the first term were in New York City, though one site was relocated, and for "Faces of Culture", only two were used. The second term saw Boston, Buffalo, and Syracuse, as well as Albany as the site locations.

Technology

In any educational setting, there will be antecedent variables over which neither learners nor faculty have direct control. In the case of this project, there were a great many. Technology was one.

Technology consisted of CLI Rembrandt communications hardware and software. Conference rooms were designed primarily for face-to-face videoconferencing though some had a second tier of tables and chairs for a classroom-like setting. Some conference rooms were relatively small, like Albany, and overcrowded. In all cases, local control of camera, audio, and graphics was managed by a keyboard at the conference table. The network video appeared simultaneously at all four sites, with site of origination determined by voice activation technology. Simply said, whoever was speaking appeared on the monitors of all

other sites, with the previous originating site appearing on the monitor of the current originating site.

Each session began with a technician available at a site remote from the instructor; in most cases the technician left once the session got underway.

INTERVENING SITUATION:

INSTRUCTIONAL DESIGN

According to Galbraith (1990), there are a number of methods and techniques used in adult education; four methods are reported in this paper as part of the instructional design.

Discussion

Brookfield (1990) argued that discussion is the preferred choice of adult educators because it can be democratic and participatory; it is good for cognitive and affective learning, and for problem setting and solving. It is most appropriate for exposing learners to diversity of perspectives and helping learners to understand underlying assumptions and demonstrate complexity of subject. The role of the discussion leader is crucial. The challenge of discussion is to attain a balance in participation between confident/articulate members and silent/indifferent members; a balance between facilitating and swaying the group towards the leader's

viewpoints; and a balance between allowing learners to attain felt needs and enabling them to explore different perspectives. The discussion model was a common foundation design shared by both courses.

Participant discussion was not hindered by multiple sites. Students were willing and ready to make their own contributions; but at times, as is the case in most discussion formats, the dialogue appeared chaotic with individuals apparently more interested in presenting their own views than in listening to, and responding to, the perspectives of their colleagues, and occasionally the instructor. The multi-site videoconference setting imposed a severe limitation on the moderator to manage the flow of thought and expression, such as by deciding order of speaking as one would in a single site environment. Voice network activation exacerbated the problem as participants appeared to speak at random, with those who were closer to a microphone having advantage.

In this method, consensus was difficult to achieve. Both instructors designed a participation protocol, but due to the voice activation feature, anyone could (and did) override the protocol. While the discussion model is an inherently democratic model, given the technology utilized, less assertive participants were disadvantaged. Not only were they less able to gain access to the network, they were also less visible to the instructor. Two techniques for remedying this problem, calling on a site in general to respond and calling on a specific individual, were not completely satisfactory.

Case Study

Marsick (1990) pointed out that the case study approach utilizes learners' experiences, it is participatory in nature, and serves as a framework for future behavior. It is best suited for applications study comprised of case reports, case analysis, case discussion; it also encourages collaboration and group decision making. "Marketing Principles" utilized the case study as a primary method of instruction.

Case study practice was fairly successful because individual sites were given responsibility to provide leadership for the solution of assigned cases. There was a sense of group cooperation and of individuals agreeing to a division of labor to report on specific sections of the process. There seemed to be some order in the presentations and the presence of multiple sites did not appear to constrain the exchange of ideas. Greater success with this method could have been attained had the students started with a better knowledge of the case study method.

Debates

"Faces of Culture" used debates as a primary panel technique. Forums, panels, and symposia, according to Sisco (1990), have deep historical roots in American democracy and citizen participation. General characteristics include open discussion with moderator, while interactivity and spontaneity can be encouraged.

The debate format was designed to encourage democratic participation and exchange of ideas while encouraging small group collaboration, in much the same spirit as were case studies used in "Marketing Principles." Debate topics relating course content with real issues in American society were announced at the inception of the course, and each site was given the opportunity to select a topic, though not necessarily the position to be taken.

Curiously, in the course with students present on site with the instructor, the student group at the instructor's site had much greater difficulty selecting a topic than students at distant sites. It was the instructor's distinct impression that the students, many schooled in traditional pedagogical models, looked toward the instructor for direction.

The debate format proved popular and allowed students to demonstrate their informed, and usually very carefully thought-through opinions. The inter- and intra-group communication makes this a particularly powerful technique for andragogical development.

Lecture

Farrah (1990) found oral presentation by a subject matter specialist most appropriate for cognitive learning. Lecture must meet particular learning objectives; it helps stimulate factual recollections; it operates within finite time constraint; and it allows for large group learning. Its primary disadvantages are that it discourages learner involvement, it may not assess audience feedback adequately, and presentation may emphasize performance over substance.

Lecture was used in both courses to cover complex material or when time constraint prevented coverage using a more interactive technique. The method, however, proved limiting. This mode was less effective because of a loss of spontaneity of interaction between learners and lecturer. While talented teachers, using a repertoire of verbal and nonverbal techniques can often hold an audience's attention and encourage interaction; without studio facilities, video technology presents a major challenge.

Instructor observations suggest that students became more passive and concentrated on taking notes, spending less time asking questions or seeking clarification of points than in either non-lecture videoconference methods or non-technology mediated lecture. When students raised spontaneous questions, it caused abrupt video interruptions (students could take possession of the network in the midst of a lecture). The smooth flow of the delivery suffered, especially when students were not at the same site as the lecturer. Lectures then became less fluid and lost much of their effectiveness.

CONCLUSIONS

Video conference technology presents both opportunities and challenges to adult educators. Careful planning and attention to detail is likely to provide an enhanced environment, especially in fostering learner

self-direction and peer collaboration. As in any technologically-based design, failure to carefully construct the course of instruction could result in disaster.

REFERENCES

Bell, D. (1976) The coming of post-industrial society: a venture in social forecasting. New York: Basic Books.

Brookfield, S. (1990) Discussion. In M. Galbraith (Ed.), Adult learning methods: a guide for effective instruction. Malabar, FL: Krieger.

Farrah, S. (1990) Lecture. In M. Galbraith (Ed.), Adult learning methods: a guide for effective instruction. Malabar, FL: Krieger.

Florini, B. (1990) Communications technology in adult education and learning. In M. Galbraith (Ed.), Adult learning methods: a guide for effective instruction. Malabar, FL: Krieger.

Galbraith, M. (Ed.) (1990) Adult learning methods: a guide for effective instruction. Malabar, FL: Krieger.

Marsick, V. (1990) Case Study. In M. Galbraith (Ed.), Adult learning methods: a guide for effective instruction. Malabar, FL: Krieger.

Pratt, D. (1988) Andragogy as a relational concept. Adult Education Quarterly, 38(3), 160-71.

Sisco, B. (1990) Forum, Panel, and Symposium. In M. Galbraith (Ed.), Adult learning methods: a guide for effective instruction. Malabar, FL: Krieger.

TEACHING FACULTY HOW TO HUNT THE INTERNET TREASURES

Kimball B. Kendall

and

Judith A. Rice

Santa Fe Community College

INTRODUCTION

The Internet is far too extensive to detail in this paper, but its salient feature is that it provides virtually any computer with a possible connection to all other computers. The educational implications of this are obvious -- vast amounts of information are potentially accessible to vast numbers of people at computer speeds. The quantity of available information combined with the increased retrieval speed create not just a difference of degree but a difference of kind; the Internet will change how teachers teach and how students learn.

It must be emphasized, however, that the Internet is not the resource; the knowledge available at world-wide locations is the resource. The advanced hardware and the software are certainly worthy of awe, but in the

final analysis they are simply very advanced tools that make the knowledge resource possible.

One software component does have an important impact on education -- the tool faculty and students use to gather information through the Internet, i.e., the user interface to the Internet. There are several interfaces to the Internet to choose from, and they range from cumbersome text-based applications that access only small pieces of the Internet to an integrated graphical user interface that accesses it all.

The academic computing staff in the Technology Resource Center (TReC) at Santa Fe Community College chose the software interface tool called MOSAIC, which utilizes the World Wide Web, because it is the most seamless tool available that accesses all parts of the Internet. It is a hypertext system (text and images are linked to other resources) that incorporates pictures, sound, and film clips. This means that individuals can literally follow their interests to resources all over the world.

MOSAIC, created by the National Center for Supercomputing Applications at the University of Illinois at Urbana-Champaign, is one of the tools that educators have been seeking. It is easy to learn and yet powerful enough to transport faculty and students past the tool directly to the resource. The choice of interface software is of paramount importance and cannot be overemphasized -- it will dictate much of the curriculum and account for a great deal of the success of the training effort.

CURRICULUM

The training program to use MOSAIC to access the Internet consists of a lecture/seminar followed by two hands-on workshops. The resource is so enormous and changing at such a rapid pace, it demands that training proceed cautiously in order not to frighten new users unduly. Faculty must reach an understanding and comfort level at their own pace. To further that end, each session reiterates several common themes: the resource is extremely large; it is constantly changing its size, content, and structure; the potential it offers to education is unlimited; and it will ultimately change the instructional process and the role of faculty.

Training activities are designed not so much to instruct, as to guide and stimulate thinking about educational questions, such as: How can this tool be used in the classroom? How will this change the classroom? How can students use this tool? How will learning be changed? How will the evaluation of the student change? How will the culture change?

The Lecture/Seminar

There are so many facts and ideas to be disseminated that faculty need a lecture-type seminar to provide an orientation and facilitate understanding. TReC does this in a lecture room which will accommodate forty to fifty people. This is done mostly for efficiency, but it also serves to generate momentum, discussion, and an understanding of the Internet culture

and the precepts that allow its existence. The specific ideas introduced are the size and growth of the Internet, its potential for education, and its major parts -- e-mail, gopher, FTP, WWW, Archie, and Veronica, some of which will be further described below. The lecture is concluded by a live demonstration that attempts to inspire as well as to educate. The demonstration includes a sampling of resources available on the Internet to the various college disciplines.

At the end of the seminar, the faculty are invited to schedule two small group hands-on training sessions. The hiatus is intentional. It allows them time to consider the Internet's potential and re-enter the training program when they are comfortable and ready to explore this new territory. The hands-on sessions are approximately seventy-five minutes long and are scheduled one week apart.

Session one

The first hands-on class introduces the interface that will be used, MOSAIC, and attempts to give the learners enough skill reference points to explore during the time between sessions. The MOSAIC menu is easily customized and was altered to provide faculty with the major points of access to the Internet as well as access to a variety of specific points of educational interest, such as the Virtual Hospital, the Museum of Paleontology, NASA, a film library, and current weather maps and satellite photos of earth.

The range of topics included not only offers something for everyone, but also serves to illustrate the

breadth of the resource. It is important to capture the learners' imagination as much as their intellect. To this end TReC takes the class to a computer in France where all the information is, of course, in French. The point is to convince the faculty that they have actually left their local computers and are elsewhere in the world.

Session two

The second class includes review of Internet "navigation," and goes on to emphasize how to search for information using two of the search engines: Archie and Veronica. The recurring themes mentioned earlier are still operative. Locations known to contain "good" information on a variety of topics are available but rarely used. No attempt is made to prevent problems, insure successful searches, or even to guide the searches. Every attempt is made to help the faculty articulate their own ideas and to understand and accept whatever results do happen. The class is a real example of what the faculty and their students will encounter and this is reinforced throughout the sessions. The second class also introduces the concepts and mechanics of file transfer and miscellaneous topics, such as the finger gateway, the listserv, and usenet newsgroups.

Faculty are encouraged to use the TReC computer laboratory as a place to experiment while awaiting their office connections to be completed. They are also encouraged to share problems or interesting discoveries with TReC and other faculty.

OBSERVATIONS

The Internet is a source of tremendous excitement to most people, but it is important to recognize the potential it has to generate great discomfort in some. The unpredictable and unrelenting change combined with the shear magnitude of this resource leave many people with that "lost in cyberspace" feeling. This, of course, accentuates the common fear of technology affecting a sizeable proportion of the population. Unfortunately, there is neither time nor method to correct these problems, but they can be minimized by discussion and reassurance. Faculty and students need to be helped to accept the concept that change is now the only constant. They need to be reassured that if a file that was seen yesterday is gone tomorrow, that this is really no different than a library magazine disappearing, and that the file is probably available somewhere else.

It is more difficult to teach a hands-on class when the students are not in lock-step at the keyboard, but the Internet invites (perhaps demands) exploration, and it is important to allow students time to find their own way. The instructor acts as a facilitator, giving just enough to get students started, then making suggestions, asking questions, and helping the lost find their way. It is impossible for any two people to have identical experiences on the Internet, even while learning it. Furthermore, all of the information resources are being updated everyday, so things appear and disappear moment by moment.

The classes change as rapidly as the resource. As of this date, no two classes have been the same. Some of this results from the Trec staff having found more interesting resources, some from resources appearing that did not exist during the previous class, but much of it results from the classes themselves finding new resources or new ideas for ways to use the resources. The culture develops quickly and seems to establish a life of its own.

FUTURE

As a result of the tremendous response from the faculty, TReC is attempting to prepare for the unknown. Questionnaires that solicit innovative ideas and suggestions have been given to everyone as they are trained and follow-up questionnaires are planned. A face-to-face user group as well as an electronic user group are being developed to present the faculty with another avenue for idea development.

GOING ONLINE: COMPUTERIZED COURSES FOR DISTANT LEARNERS

Kathleen King

Idaho State University

INTRODUCTION

The western United States, an area of vast distances, extremes of weather, and sparse population, creates difficulties for would-be university students in isolated small towns. A roundtrip drive of four or more hours discourages many who might pursue higher education. Idaho State University, located in Pocatello (population 50,000), tries to bring higher education to the people of southeast Idaho. University buses transport students from smaller cities to the main campus. Most out-of-town students arrange classes to make the long trip two or three days each week. An alternative method of delivering classes requires professors to drive to distant locations.

In a region where snow is possible at any time of the year, and probable from October through April, travelers sometimes must choose between missing classes and driving in dangerous conditions. Hazards are not limited to snow and ice. One night while driving home from a class in Soda Springs, this writer saw a herd of

mule deer filling the highway at Fish Creek Summit. Faced with alternatives of hitting a semi, driving over a cliff, crashing into a rock wall, or trying to steer through thirty deer milling in the road, the least dangerous action was chosen. Although the writer was not personally hurt, one animal was seriously injured, and the university car suffered major damage -- the fourth time that particular vehicle had been involved in such an accident.

Idaho State University regularly offers telecourses to students at university centers in Idaho Falls and Twin Falls. The professor lectures to a class in Pocatello, with audio and video transmission to distant locations. Some students attend class in the television studio, while distant students participate by audio link. Other courses are taped and shown on the Me/U cable television network. However, television students are passive receptors of information who do not have the opportunity to participate in dialogue with the professor.

A teaching method which will allow students to access university courses from many locations, learning centers as well as individual homes, utilizes university computer facilities. Students connect to the Idaho State University mainframe computer by modem for lectures and discussions. Written materials include textbooks and a user manual; the manual describes how to use email, class and individual subdirectories, and computer conferencing. Live television, videotaped, or CD-Rom lectures could be added to the basic format to enhance learning.

LITERATURE REVIEW

Online and manual searches revealed a number of publications about successful online courses. Monro (1987) described the use of email and computer-based feedback for external students. Email allows external students to have the same regular communication with professors as those on campus, and feedback helps professors assess learning and direct students to appropriate sections in texts and notes. Professors are able to give students individual help with problems. Bang and Moller (1990) reported on six courses taught at Jutland Open University in Denmark during 1988-89 using PortaCOM, a Swedish system. Classes contained 20 to 35 students and met face-to-face for seminars five or six times per year. All other class sessions were conducted online. Students with computers at home liked the system, but others did not, and seemed unwilling to go to outreach centers where computers were provided.

Two one-month courses are the focus of an article by Manninen (1991). Students were given the option of doing coursework in an online discussion group. The success of this endeavor depended on daily access to computers, ability to use the equipment, and willingness to complete assignments individually.

Paulsen (1991) reported on innovative uses of computer conferencing in university teaching. The system provided more information at less cost, built a safe learning community with opportunities for collaborative

learning, and gave students access to staff members who monitored and checked their learning.

A collaboration between professors in the United States and Mexico used Bestnet (Watkins, 1993). The system provided online discussions and lectures, team teaching, an extension program, and electronic coffee houses where students and professors could gather to talk informally. Students who were bilingual in English and Spanish made extensive use of the system.

In the late 1980s, the Big Sky Telegraph began linking isolated Montana schools to the outside world (Rheingold, 1993). Gifted Montana students were taught physics by MIT professors, a women's resource center helped rural women train for jobs requiring computer skills, and Native Americans exchanged alphabets and graphic designs. The success of the Big Sky Telegraph showed that computer networks which link isolated users can provide educational opportunities as well as a sense of community.

Some university administrators fear that online courses may inhibit professor-student and student-student relationships. Moore (1991), explained such contacts in terms of "transactional distance." Physical distance between teachers and learners does not affect transactional distance, which is a function of course structure and opportunity for dialogue. Although online communication may lack the nonverbal cues of a face-to-face class, the opportunity for extensive dialogue during online conferences decreases transactional distance. Moore found that problems posed by technology which detracts from the subject matter can be overcome with

user training, and long-distance phone charges are eliminated by an 800 connect number.

CONNECTION OPTIONS

Commercial computer services such as Prodigy, Compuserve, and America Online already provide educational opportunities to users. For instance, the Electronic University Network, a private company, offers credit and noncredit courses via America Online (AOL), a tested system with user-friendly software and local access numbers so that users do not incur long-distance telephone charges. Colleges participate by offering courses, and students become AOL users. The audience is nationwide (AOL) or even worldwide (Compuserve). Connect time cost is a negative factor of commercial services.

An alternative utilizes a university mainframe accessed by modem from home or study centers set up by local school districts. Idaho State University has an initially intimidating but ultimately easy-to-use system in place and operating. Students on or off campus, as well as community users, pay a $10 per semester fee in return for access to computer facilities, including Internet. An 800 access number, not yet available, will eliminate long distance charges for distant students.

Basic hardware requirements are a computer, a modem, and a telephone line. Co-session software, which enables users to access the mainframe computer, can be downloaded in on-campus computer laboratories.

Students at distant locations can be mailed a diskette containing Co-session. The mainframe provides access to many types of software for word processing, graphics, number crunching, etc. With Co-session, files can be transferred between the mainframe and the user's home computer.

PLANS FOR AN ON-LINE COURSE

An on-line course is planned by the writer. Students will preregister, and after fees are paid, they will receive a packet containing course materials, including textbook, computer system user manual, Co-session software and installation instructions. Students will be invited to login and try out WordPerfect, the class subdirectory, email, and the English Chat Room. The class subdirectory contains permanent and temporary files placed there by the professor. Permanent files, which stay in the subdirectory throughout the semester, include the user manual, the syllabus, and the schedule of assignments. Temporary files change from week to week: detailed assignments, vocabulary lists, study questions, quizzes, and grading criteria. Students can retrieve files and save them on their individual subdirectories. In addition, they can save completed files for the teacher. Students cannot retrieve each other's files unless the professor resaves the files, and only the professor can delete or rename files.

Email allows teacher and students to exchange messages and files. Students are periodically asked to

email the professor to report on the progress of a reading or writing assignment, and the teacher replies with suggestions and support. This intimate medium enables students to ask questions and receive individual attention. In addition, the instructor can model writing techniques to teach style in a subtle, intuitive way. When distant students exchange email with each other, they form a community. If the class is divided into workshop groups, group members attach their writings to email files and send them to each other for comments or group discussion.

Scheduled online sessions via the English Chat Room can involve a whole class, small groups, or individual students. A combination of formal class sessions and informal office hours connections allows the teacher to lead a discussion about the textbook or student writings with all class members, go over the week's writing with a small group, or help one student with a flawed premise. Online discussion enhances the sense of community, and gives the teacher another opportunity to model writing techniques.

A simple online chat is easy for computer center staff to set up and allows class members to participate equally in discussion. All participants can send and receive conversation, and a whisper capability allows private exchanges. Drawbacks of this simple system include inability to save conversation and lack of face-to-face contact. However, transactional distance is reputed to be narrowed by dialogue, the format of the online conference.

The basic format of a class subdirectory, email, and online conferencing could be enhanced by other teaching methods. A class might include both users in a campus computer lab and distant learners, or out-of-town students could attend a few on-campus class sessions to reduce transactional distance. Lectures might be delivered by television, videotape, or CD-Rom, then distant students would login to the Chat Room for a scheduled discussion.

CONCLUSIONS

The popularity of courses offered by commercial networks makes it clear that many home users would like to pursue educational opportunities online. For the past five years, this author has been teaching all of her courses in the Liberal Arts Computer Lab at Idaho State University, classes in which students did all of their writing online, used individual and class subdirectories, and exchanged email.

This semester, experimentation was conducted with online discussions. An early attempt resulted in a disorganized discussion with many tangents, but after practice, students were able to stay with a line of thought, and many participated actively. The basic system is already in place, and enhancements such as video lectures and an 800 number can be arranged. Online courses offer a connection to the world for would-be students isolated by distance from opportunities to pursue higher education.

REFERENCES

Bang, J. and Moller, M. (1990) Computer conferencing in Danish distance education. In A. W. Bates (Ed.) Media and technology in European distance education Milton Keynes, UK: Open University, PP. 249-252.

Manninen, J. (1991) Computer conferencing and self-directed learning - experiences from computer-mediated facilitating. Fifth Annual Symposium on Adult Self-Directed Learning, Norman, Oklahoma, February 24-26.

Monro, D. (1987) Quality distance education = computer based feedback + electronic mail. In J. Barrett & J. Hewdberg (Eds.) Using computers intelligently in tertiary education. Australian Society for Computers in Learning, November 29-December 3, 147-152.

Moore, M. (1991) Distance education theory. Deosnews, 1:25.

Paulsen, M. (1991) Innovative computer conferencing courses. Deosnews, 1:14.

Rheingold, H. (1993) The virtual community. Reading, MA: Addison-Wesley.

Watkins, B. (1993) Breaking down barriers. The Chronicle of Higher Education, March 23, A25.

TEACHING NON-SCIENCE STUDENTS COMPUTER SCIENCE AND TECHNOLOGY: IF THIS IS OLD NEWS, WHY AREN'T WE DOING SOMETHING ABOUT IT?

P. A. Kuntz

G. P. P. Kuntz

and

W. Freed

Concordia College

INTRODUCTION

This paper explores the need to redesign the introductory computer science literacy course offered to non-science majors in academic programs. Such courses need to be changed to meet the present and future needs of students and society. Computer technology is one of the chief "enablers" for the future. It is important for

students to be offered the opportunity to develop some degree of expertise with the technology. Students need appropriate computer skills because technology is only as good as the context in which it is used (Kinnaman, 1990).

PRACTICAL WISDOM &

CONTENT ESSENTIALS

Most universities follow a standard content pattern. Course topics usually encompass literacy, applications, and might include problem solving, as in Table 1 below. Schools use the lecture format for course delivery. The material is often presented in a dull manner, and it does not really motivate students to pursue material on their own.

TABLE 1 Content and Process

Critical thinking

component one	component two	component three
Literacy	Software applications	Problem solving
History	System	Programming
Uses	Wordprocessing	Spreadsheets
Costs	Spreadsheet	
Hardware	Database	
Privacy	Statistical	
	Graphic	
	Desktop Publishing	
	Communication	

Changes in content and course delivery are needed. Certainly, a literacy component should be included as a part of the introductory course, and it should be designed to be as interesting as possible. Literacy can be used as the bait to entice students to build a firmer foundation in information technology. Bells and whistles help to sell the product.

A second component might well be developed around application software. A component on software concepts should involve learning to use word processors, spreadsheets, databases, statistical packages, graphic software, time management programs, and desktop publishing packages effectively. It is important for students to be acquainted with the use of such software because most students will need a working knowledge of such materials when they enter the workforce.

Undergraduates can be taught the essentials of software in a few weeks and left to explore additional uses on their own time during the remainder. Instructors and/or lab personnel should be available and willing to handle students' questions and problems during the duration of the course. Applications are important, but there is no reason for software to be anything other than one of several parts that make up the introductory course.

The third component might be built around the teaching of critical thinking and problem solving. This is accomplished by teaching students logical problem solving using a programming language. There is strong evidence that teaching programming improves the students' ability to find solutions to problems in general

and allows for the transference of such knowledge to other situations (Norris, Jackson and Poirot, 1992). Students can learn to build strategies, to plan logically, to execute a successful solution to a problem, and to view and use the computer system's capacity as a tool.

However, students need close supervision and support to become truly thoughtful programmers, and they need help in learning the skills involved in the transference of knowledge that can be the end result of a good programming course (Lieberman and Linn, 1991). Most students do not transfer skills by themselves. The instructor must set this as one of the main objectives of the course. Usually instructors need a wide and varied background across academic subject areas to be able to help students understand and use the technique of knowledge transfer.

Student programmers have much in common with philosophers; both must develop a step-by-step plan in search of a solution to a stated problem. Similar experience might be gained through a course in introductory symbolic logic. Similar to that of the philosopher's response, the program is typed and a run attempted. Self confidence builds in student programmers with the successful completion of the program.

Students who are taught to program with some degree of skill can develop new levels of problem solving ability and realize new knowledge (Campbell, 1992). After the program is completed and students move on, they often realize that the plan or approach can be used to solve other problems. This is an excellent example of the transference of knowledge.

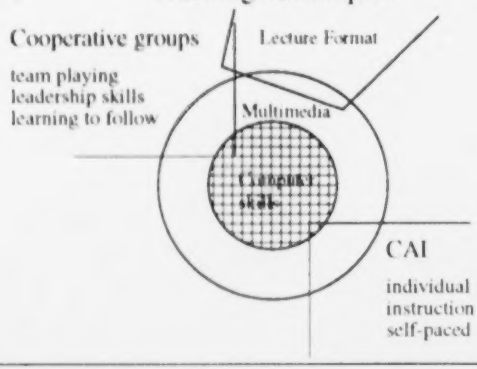
ALTERNATIVE INSTRUCTIONAL STRATEGIES

Problem solving taught in a close, cooperative atmosphere allows for the learning of alternative problem solving approaches. Programming concepts can be executed very nicely under the context of cooperative learning. This type of learning experience allows for cognitive learning while promoting high levels of personal acquirement. If correctly structured and facilitated, it can create an atmosphere of competition within and between groups that Liberal Arts students are seldom allowed to encounter. The social contingencies developed using this type of learning structure will be very familiar to business and education students (Sapon-Shevin and Schniedewind, 1992).

An alternative approach to the traditional manner of teaching computing or computer applications courses might be to consider applying multimedia techniques. Non-science students respond well to a visually oriented presentation, and to materials presented in a manner built around pattern recognition (Badre and Shneiderman, 1982).

Figure 1 illustrates the approach which allows students to see technology being applied as a powerful tool. Although multi-media presentations require planning and time, they can be used effectively with large classes.

FIGURE 1 Teaching Techniques



Some pointers for this type of approach might include: the use of an outline at the beginning of each class covering the day's topics, presentations, and/or guests; avoiding the use of the blackboard for class presentation (this helps prevent having an instructor's back to the student group); using simple, concrete imagery as a metaphor for the more difficult, abstract ideas (multimedia presentations are excellent in this area); assuming a persona for this type of class which permits the use of the unusual; and always using humor.

Both multimedia techniques and large classes require that instructors be available for students' questions. This requires time be set aside in a consistent pattern, and that office hours and help sessions be established and kept. The use of multimedia in large classes makes the delivery proficient and productive (Herteis, 1992).

The positive points of the cooperative teaching environment have already been discussed; however, there is much to be said for the use of computer-assisted instruction (CAI) in technology teaching areas. While CAI is at the opposite end of the teaching spectrum from cooperative techniques, it can work well in this area.

Self-directed learning and CAI allow students to work at their own pace and give the student confidence at working with a computer. CAI and self-directed learning allow lab support staff (and even professors) to help those who most need and want help. Certainly, self-directed learning is ideally suited to teaching programming and applications component. If there is to be a mass shift to tailored learning, computing and/or technology education are areas that would benefit and thrive (Willis, 1992).

INSTRUCTOR AND LEADERSHIP

The responsibility for course quality falls on the shoulders of the instructors. This is one of the reasons that it is important for all instructors to be well qualified and interested in teaching (Kearsley and Lynch, 1993). An important rule might be phrased...be willing and able to impart professional knowledge to students and colleagues with grace... because the instructor should be a facilitator of knowledge. Such teaching requires instructors who understand the teaching of problem solving, have the knowledge necessary to access the students' learning styles, and possess a high degree of professional understanding and training (Davidson, 1992).

CONCLUSIONS

There must be full cooperation within institutions concerning all aspects of computer and information science because of the importance to students of such course training and the high cost of delivery of such course offerings. Computer and computer generated technology are not going to go away; all fields are changing because of such technology. It is time for computer technology knowledge courses to receive the attention needed to make them first rate. Even with voice input as a technology tool, it is still important for students to understand how and why the machine works, to better understand what the computer can and cannot do as a tool.

If positive decisions for improvement are not made from within universities, then these changes will eventually be imposed by an outside body. Imposed requirements will probably not meet the needs of the individual programs or budgets. It is time to realize that technological knowledge must become a priority.

REFERENCES

Badre A. & Shneiderman, B. (1982) Directions in human computer interaction Norword, NJ: Albex Publishing Corp.

Campbell, N. J. (1992) Enrollment in computer courses by college students, computer proficiency, attitudes & attributions. Jounal of Computer Education, 25(1), 61-74.

Davidson, G. V., Savenyue, W. C. & Orr, K. B. (1992) How do learning styles relate to performance in a computer applications course? Journal of Research on Computing Education, 24 (3), 348-358.

Herteis, E. M. (1992) Teaching large classes well. Focus on University Teaching and Learning, 6, 1-4.

Kearsley, G. & Lynch, W. (1993) Educational leadership in the age of technology: the new skills. Journal of Research on Computing in Education, 25(1), 50-60.

Kinnaman, D. E. (1990) The next decade: what the future holds. Technology & Learning, 43-49.

Lieberman, D. A. & Linn, M. (1991) Learning to learn revisited: computers and the development of self-directed learning skill. Journal of Research on Computing in Education, 23(3), 373-393.

Norris, C., Jackson, L. & Poirot, J. The effect of computer science instruction on critical thinking skills and mental alertness. Journal of Research on Computing in Education, 24(3), 329-337.

Sapon-Shevin, M. & Schniedewind, N. (1992) If cooperative learning's the answer, what are the questions? Journal of Education, 24(2), 11-37.

Willis, N. E. (1992) The impact of information technology on the future context of learning: some questions. British Journal of Educational Technology, 23(3), 232-233.

REALITY: LEARNING THROUGH COMMUNITY BASED PROJECTS

Leslie H. Lightbourne

The University of Findlay

and

Frank M. Bosworth

Bowling Green State University

INTRODUCTION

The call for reform is occurring at all levels of education -- from kindergarten to graduate school. The pressure to prepare students to become critical thinkers who not only know facts and figures but also can reflect, draw from various disciplines, critically analyze, apply, and evaluate has become important at all levels (Goodlad, 1994).

Compounding these demands is the need for skills in collaboration, teamwork, and problem solving which is even reflected in the terminology of "want ads". The content-focused approach of lecture, discussion, write, and test does not provide the experiences necessary to

prepare students to function productively in a rapidly changing world. To meet these needs, the learning environment and experiences must engage students in meaningful learning.

Schools also do not function in isolation: they have a mission outside of themselves, embedded deeply in a public context. Perusal of a newspaper indicates the criticism and demands from the public sector for schools to become involved in the community. In response, a collaborative infrastructure has been described as being developed among agencies, industry, schools, and families to develop the multiple intelligences needed to function in a world of change (Gardner, 1983).

In the 1980's, there was a movement toward reality based learning through methods such as case studies, field experiences, and internships. The case study approach is successful in engaging students in higher order levels of thinking; however, it is often difficult to find existing case studies which support the objectives of a specific course, and it is definitely time consuming to write original case studies (Bosworth, 1993). Field experiences and internships frequently do not have clearly defined academic objectives and are inadequately structured and supervised.

In teacher education, a major dilemma is that the teaching and learning strategies taught in teacher education courses are often not exhibited by the practicing teachers during the field experiences. This cognitive dissonance may prove to be a positive learning experience for the student, causing them to reflect upon and evaluate what they have experienced; however, often it causes them to revert to ineffective strategies.

An approach which engages the students in reflection and problem solving within a wider context than the school is the community based project. It also, of course, has limitations. It is time consuming, the project can become all encompassing for students and faculty, and faculty must yield most of the responsibility for students' learning to the students' themselves. In addition, the faculty member has added another external measure of accountability -- the community must be provided with feedback, and hopefully, possible solutions.

Despite these drawbacks, this approach has the advantage of being reality based while allowing faculty added control of the experience and the measured objectives. The interaction with the community and the feedback regarding their work from others outside the academic environment enhances the importance and relevance of their coursework for students.

DEFINING COMMUNITY BASED PROJECTS

Community based projects engage students in the solution of a problem that exists within the context of the community. The faculty selects the problem based on its ability to provide structured learning activities for students which meet the specified goals or objectives of a course or program (Bosworth, 1993). To reflect the need for individuals to be able to work collaboratively with groups, this approach requires students to work in groups assigned specific tasks which are necessary for the solution of the overall problem.

Though easier to manage and probably most effective in smaller classes, one of the advantages of this approach is that it can be effective with larger class sizes, for problems tend to be multifaceted requiring a myriad of different tasks to solve them. Students are required, within the context of their group, to assign individual tasks which require them to not only act as creative, independent problem-solvers, but also to harness their creativity through organization and planning to achieve the overall goals (Casey and Howson, 1993; Zechmeister and Johnson, 1992).

Community based projects are being used successfully in different disciplines. As an example, within the context of an undergraduate teacher education course with large enrollment (78 students), students developed, administered, and evaluated the results of an opinion study regarding inclusion of children with disabilities in typical classrooms. The survey was administered to teachers, administrators, politicians, psychologists, and other ancillary staffs. The results were compiled and presented to a task force both orally and in report form.

As an example of a quite different course using this method, students in an undergraduate architecture class conducted a comprehensive study of the logistics of relocating a historical building onto a historical site. The students conducted interviews, performed a site evaluation, documented the existing building, requirements for disassembly and reassembly of the building, coordinated logistics for moving the structure, and prepared and presented a comprehensive report on the project.

Empirical research on community based projects is just beginning; however, measures of student learning and perceptions of the process are being evaluated and have been supportive of the approach. Over 90% of the students in the undergraduate architecture class responded "community" when asked at the conclusion of the project "If you could choose to do this project in the 'studio' setting without community involvement or with community involvement, which would you choose?" (Bosworth, 1994).

Following the project, students were asked to rate their learning compared to other classes, attainment of the class objectives, and overall experience. The results were 4.7 - 4.9 with a possible high score of 5.0. (On the university required faculty evaluation for the education class, students rated the teacher low in "lecture skills", citing that the teacher actually did a minimal amount of lecture and, therefore, could not be rated on this variable!) As more community based projects are used, further empirical studies need to be conducted regarding its effectiveness.

THE TEACHER'S ROLE IN COMMUNITY BASED PROJECTS

Teachers of classes using community based projects serve many roles; however, the primary role is that of facilitator of the process. The involvement of the teacher changes throughout the different stages of the project. In

the initial planning, the teacher works fairly autonomously, establishing clear and concise goals and objectives for the course, and considering possible community projects which would engage students in activities reflective of the course goals and objectives. Projects can come from a variety of sources: professional contacts in the community; television; newspaper articles about the community; and larger issues (such as inclusion of students with disabilities and environmental waste) which impact the local community and present a problem which can be addressed.

Following identification of a possible project, clear and concise goals for the project must be created which will meet the community's needs and address objectives and goals of the course. The objectives for the project describe the activities the students will undertake to reach the overall goal. The initial contact with the agency or organization in the community is done by the teacher to develop realistic expectations and the goals for the project.

The students will be involved in the interaction with the community component after the beginning of the project; however, the development of the framework for the project must be made by the teacher. As the project develops, the teacher may also have to intercede if expectations from the community exceed the parameters of the project.

Teacher and students work together to describe the tasks necessary for completion of the project, establish groups to complete each part, and prepare a schedule which is reflective of the academic schedule and the requirements of the community. Opportunities for

frequent intergroup exchanges is vital for executing the project. Students need to be provided with opportunities for sharing their progress, receiving feedback from their peers, drawing on expertise from their peers, and problem-solving as a group when difficulties arise. Students need to develop guidelines for this process and for conflict resolution in the initial stages of the project.

Cooperative learning and problem-centered approaches are the operative modes of instruction when using community based projects. The teacher's primary responsibility is to facilitate the planning and activities to insure that the class goals are being achieved and the groups are able to achieve their designated tasks. This may involve acting as a consultant, guiding students to needed resources, or giving a "mini-lecture" to provide necessary content expeditiously while introducing strategies for problem-solving.

In larger classes the above can become quite hectic, necessitating clearly defined time allotments for each group to have contact with the teacher. Designation of additional time outside of class for consulting, if further assistance is needed, has also proven helpful.

During this process, a major task of the teacher is to promote reflection. Community based projects require students to depend upon and to be accountable to every other student in the class and to the community participants (Kohn, 1987). As a formative evaluation, requiring students to discuss and evaluate relationships, in and among groups, as well as their individual performance, can enhance reflective thinking and collaborative learning skills.

CONCLUSIONS

Community based projects, as instructional tools, build on the problem centered approaches to teaching to provide challenging, relevant, and motivating experiences for students and teachers. They require teachers to reflect on their roles and to modify their interaction with students. The students must take responsibility for their learning and be reflective about their knowledge and abilities within the content area. Each must learn to function effectively as a team member. Carefully planned community based projects can provide experiences which enhance the desired outcome -- students developing a permanent connection between the strategies they learned in their courses and the eventual practice of their professions.

REFERENCES

Bosworth, F. M. (1994) Unpublished ms, Bowling Green State University.

Bosworth, F. M. (1993) Problem centered teaching and learning using community projects. In J. A. Chambers (Ed.) Selected papers from the 4th national conference on college teaching and learning. Jacksonville, FL: Florida Community College at Jacksonville.

Casey, M. B. and Howson, P. (1993) Educating preservice students based on a problem-centered approach to teaching. Journal of Teacher Education, 44(5), 361 - 369.

Gardner, H. E. (1983) Frames of mind: the theory of multiple intelligences. New York: Basic Books.

Goodlad, J. I. (1994) Educational renewal: better teachers, better schools. San Francisco, CA: Jossey-Bass.

Kohn, A. (1987) It's hard to get left out of a pair. Psychology Today, 53-57.

Zechmeister, E. B. and Johnson, J. E. (1992) Critical thinking: a functional approach. Pacific Grove, CA: Brooks/Cole.

INTEGRATING THE ELECTRONIC DESKTOP INTO THE SCIENCE CURRICULUM

Gary A. Novak

and

Robert A. Desharnais

California State University, Los Angeles

INTRODUCTION

The PC industry is changing. Faster CPUs, increased storage, higher resolution monitors, more sophisticated peripherals (CD-ROMs, laser printers, fax modems) are available at decreasing prices. Operating systems are graphically-oriented, user-friendly, and powerful (multi-threading, network-savvy, object-oriented). These advances provide an opportunity to change the way instructors teach and students learn. At California State University, Los Angeles (CSLA), a multi-disciplinary faculty team is collaborating to integrate workstation technology into the science curriculum.

Project faculty are teaching in a powerful, user-friendly, interactive computer workstation

environment where scientific processes can be visualized and explored. They use multi-media email to enhance instructor-student and student-student communication; they use intuitive graphical software to bring the resources of the Internet into the classroom; they use powerful software "objects" as building-blocks for custom-courseware.

This paper describes the electronic desktop project that began in the Fall of 1992. The project goals are to engage students, make science more accessible to a culturally diverse population, make science teaching exciting, and increase technological literacy.

THE UNIVERSITY AND ITS STUDENTS

CSLA is one of the most ethnically diverse universities in the nation. The campus is located five miles east of the downtown area near several predominantly Hispanic, Asian-American, and African-American neighborhoods. Of CSLA's 18,000 students, over 78% are from these groups. Women constitute 58% of the student body, the average student age is 27, and 95% are commuters. CSLA students are from lower and middle class backgrounds and most work more than 20 hours per week.

Learning is made more difficult by a variety of factors. English is not the native language for over two thirds of CSLA students, and many write and/or speak it poorly. Many received their primary and secondary education in a foreign or underfunded, overcrowded,

inner-city school. The demands made on them at CSLA are different from their past experiences. It is part of the CSLA mission to educate these individuals.

The authors believe that visualization and interactive computer simulation can help overcome these obstacles. To this end they obtained funding from the university and the National Science Foundation to establish an electronic desktop facility.

THE NEXTSTEP INSTRUCTIONAL LAB

The facility consists of 20 networked color NeXT and Intel 486 workstations running NEXTSTEP, an advanced Unix-based operating system which integrates object-oriented technology, standard networking, and a powerful and easy-to-learn graphical user interface. All workstations are networked to a file server with Internet access. Student lab consultants provide assistance during open access hours. In the first project year, 40 sections of 14 different courses have been offered to over 700 students.

COURSEWARE DEVELOPMENT

Custom courseware development is a component of this project. Figure 1 shows an example of one of over 30 applications covering several scientific disciplines. Five applications have been developed in collaboration with

two student programmers; the remainder were written by project faculty members.

FIGURE 1. Screen Image of the Flylab Application

Custom applications were used to explore basic scientific principles. They emphasize problem-solving, not a presentation of facts. For example, in a biology class, each student, assigned a pair of mutations, used FlyLab to design and carry out genetic crosses to discover the characteristics of the assigned traits.

Spreadsheets, word-processors, and graphic illustrators are used by students to learn to tabulate and analyze data, understand and model statistical principles, improve writing skills, and apply principles of visualization of scientific information.

MULTIMEDIA ELECTRONIC MAIL

The NEXTSTEP electronic mail system is easy to use, compatible with email on the Internet, and allows the transmission of formatted text, graphics, voice, applications, and files. Images and files can be included by a simple drag-and-drop operation. Voice messages are created using a sound box or microphone. Grouping email accounts facilitates communication to classes.

Messages received are identical to those sent. Users reverse drag-and-drop operations to retrieve images and files. Icons are double-clicked to run a program and load a file. This intuitive ease-of-use is essential for individuals who lack computer literacy. Students have little trouble mastering NEXTSTEP Mail.

Course materials are delivered in a paperless environment. Email promotes communication among faculty and students and mitigates the constraints of schedules and office hours.

RESOURCES OF THE INTERNET

Project faculty employ user-friendly, graphical applications that give access to the resources of the Internet (via anonymous FTP, gopher, Usenet newsgroups, and World-Wide-Web). A terminal shell can be used to access databases and library OPAC's. Students who were required to develop projects or write term papers conducted their research on-line. For example,

students explored the ocean/atmosphere interaction by down-loading time-sequenced satellite images of hurricane Hugo and constructed an animation of the intensification of Hugo over the warm Gulf Stream waters.

PROJECT EVALUATION

Anonymous student questionnaires indicate that using the NEXTSTEP Instructional Lab was a rewarding experience. When asked if their understanding of course materials was improved, the responses were predominantly positive. They indicated that NEXTSTEP was easy to use, email enhanced communication, and the electronic desktop was useful for other coursework. Some felt that lab access was a problem. Students overwhelmingly agreed that they would like to continue learning in the NEXTSTEP Instructional Lab.

CONCLUSIONS

The electronic desktop approach is an effective way to engage students from all racial and ethnic groups in the learning of science. Interactive learning is more effective and more fun. Teaching becomes more exciting and project faculty feel rejuvenated by their involvement. Communication and collaborative learning are enhanced

and student research is facilitated. This paradigm has important pedagogical potential.

Anecdotally, CSLA students have formed their own NEXTSTEP user group with over 80 members. In their biweekly meetings they conduct software demonstrations, tutorials, and share information gathered from the Internet. Their involvement and enthusiasm is gratifying.

A TEACHING SCHOLARS PROGRAM TO DEVELOP PROBLEM-SOLVING MOLECULAR BIOLOGY EXPERIMENTS

Herbert B. Posner

and

Thomas P. O'Brien

Binghamton University

and

James Markstein

State University of New York

College at Oneonta

INTRODUCTION

There is a national need --- a need that will extend into the next century --- to produce capable molecular biologists as basic and medical researchers, educators

and biotechnologists. More undergraduates, especially underrepresented minorities, must be suitably educated, stimulated and encouraged to specialize in molecular biology. It is, however, in the high-enrollment introductory courses with multiple laboratory sections that many students either are discouraged from or lose interest in pursuing a specialization in molecular biology.

What is "turning off" students? Informal feedback from students at Binghamton University as well as more formal feedback from students elsewhere has cited, among others, excessive competition, lack of active student participation, inadequate equipment and "cookbook" laboratory exercises as contributors to student dissatisfaction (Paldy, 1989; Wineke, 1991).

To overcome these problems and, in the process, revitalize the freshman experience in molecular biology, train and encourage students to become teachers of molecular biology, and enhance the effectiveness of teaching assistants, the following approaches are being used at Binghamton University. The introductory molecular biology course is being restructured to include open-ended, student-directed investigations (Fogle, 1985) in a collaborative, research-team setting. Students practice biology the way researchers do, by designing and doing experiments, and then analyzing and interpreting the results.

The above changes in the laboratory course are expected to have positive effects on students' achievement and career aspirations (Oliver and Simpson, 1988). Further, the use of collaborative laboratory teams complements the cooperative learning approach being

used in the introductory molecular biology lecture course (Posner and Markstein, 1994).

To help implement these changes, a teaching scholars program and a teacher-training workshop have been established. The upper-level undergraduate teaching scholars design and test potential student-directed experiments and participate in the workshop in preparation for their roles as co-teachers in the laboratories. The hope is that these experiences will also encourage students to pursue careers in biology education.

DESCRIPTION OF THE PROGRAMS

The Teaching Scholars Program

Upper-level undergraduate applicants who have performed well academically and have exhibited the communicative and interpersonal skills necessary for teaching are invited to join the Teaching Scholars Program. For six weeks in the summer, during which they receive a stipend, they assist faculty in the restructuring of both the content and the instructional approach of the introductory molecular biology laboratory classes. The Teaching Scholars do the experimental work needed to establish the general class experiments; then, playing the role of students in the class, they work in collaborative teams on a range of investigative projects to determine their suitability for the introductory laboratory class. These were not easy tasks. The more structured, introductory, skills-oriented ("cookbook") phase and the

independent approach had to be developed within certain constraints: time limitations (the teaching lab period was three hours long) and equipment and budget limitations (the course is taught to over 400 students).

Developed Laboratory Modules

Before any problems could be solved experimentally, students must be taught the appropriate methods and procedures. Thus, it was not possible to completely eliminate the "cookbook" approach, but the students were made aware that they were doing more than busywork. In the way scientists do research, students would first have to learn the appropriate techniques before doing any problem-solving.

ENZYME MODULE. The enzyme tyrosinase, a cellular catalyst involved in the formation of the pigment melanin, is of importance in phenomena that students could relate to, namely, skin pigmentation as well as the browning that occurs in ripening or damaged fruits and vegetables.

First, the "cookbook" phase: working in groups of four, students learn the methods and materials for extracting, partially purifying and measuring the activity of the enzyme. The organization and analysis of data and the writing of reports are done through the use of graphic, database and word-processing software.

Next, the collaborative problem-solving phase: teams are presented with problems from which to choose. An example -- when lemon juice is applied to cut apples, browning is prevented or at least slowed down; does this have something to do with the inhibition of tyrosinase

and, if so, which component of lemon juice is the inhibitory factor? A second example -- at one time (before health problems were discovered), sulfites were sprayed on vegetables in salad bars to prevent browning; does sulfite inhibit the enzyme; does sulfate have the same effect?

Members of teams collaborate on the choice of problems and the design of the experiments. Then, after consultation with the teaching assistant, the experiment is done, and the results are discussed and interpreted by each team. Each student submits a report in the form of a scientific paper. A similar approach with the enzyme catalase has been used in an introductory course at Drexel University (Martin, 1993).

THE DNA SCIENCE MODULE. This month-long series of activities and research problems deals with a phenomenon relevant to a current medical problem, namely, the increase in antibiotic resistance among disease-causing bacteria. The "cookbook" phase teaches basic techniques in microbiology and molecular biology, including the separation and identification of different kinds of genetic information (DNA); the transformation of antibiotic-sensitive bacteria to antibiotic-resistant bacteria by treatment with DNA containing the gene for resistance; and the extraction of DNA from bacteria.

Based on the above, students are asked to design an experiment to test the following hypothesis -- **transformation is due to the uptake and incorporation of the resistance gene into the information systems of the bacteria.** As in the previous module, members of the research teams design and perform the experiment and then write reports.

The Teacher-Training Workshop

During one of the semesters following the summer, each Teaching Scholar is assigned to co-teach one laboratory section with a graduate teaching assistant. The lack of training for teaching assistants in charge of laboratory and recitation sections has been cited as a national problem (Lumsden, 1993); the previously discussed laboratory restructuring and collaborative learning approaches made the need for training especially compelling. Accordingly, a course was developed for undergraduate teaching scholars and interested new graduate teaching assistants.

The course, "Principles and Practice of College Biology Teaching", addressed: 1) basic principles of cognitive psychology and constructivism as applied to biology teaching (Shuell, 1987); 2) misconceptions in biology and problem solving strategies (Smith, 1991); 3) development of pedagogical skills, especially collaborative learning techniques (Johnson et. al., 1990); 4) critical analysis of the new laboratory modules; and 5) teaching assistants' job responsibilities.

Additional topics in the fifteen weekly, 1.5 hour classes included: study problems; concept mapping; evaluation techniques; learning styles research and the instruction of women and minorities; and videotaped microteach presentations.

FINDINGS

Questionnaires were administered to students in the laboratory course at the beginning and end of the semester. (These students will be tracked for the next few years to determine their academic choices and achievements.) The teaching assistants in the course (graduate and teaching scholar co-teachers) were asked for their opinions of how well the idea of research projects was accepted by students and how well they were performed. For evaluation of the teaching course and the teaching scholars program, the participants were surveyed. They are also being tracked to determine their post-baccalaureate choices and achievements.

Restructured Laboratories

Of the 404 students enrolled in the Spring 1993 semester, 308 completed the initial survey and 391 completed the final survey. Of these, 183 were matched by social security number between the initial and final versions. These students will be tracked to assess progress, course selection, academic achievement and career plans.

The survey results were similar for minority and non-minority students. Initially, about 40% indicated some background or confidence in using the molecular biology equipment listed in the survey; at the conclusion of the course, 85% were comfortable and confident in the ability. Initially, few students had any confidence in their ability to conduct open-ended research; at the conclusion

of the course, the majority indicated increased confidence. This result was reflected in the finding that initially about 35% planned to do independent research as juniors or seniors compared to about 50% following the course.

The degree of student involvement in the restructured laboratory is indicated in the comments from one of the graduate teaching assistants who had also taught the course before restructuring: "I have never seen...students engaged in their lab work to the degree they were...". These students were not only working hard but also were being stimulated by their experiences. The following academic year there was a dramatic increase in the demand for the elective upper-level courses in molecular biology (from 80 the previous year to 160) and microbiology (from 110 to 170). A similar increase was noted in the number of requests for independent research.

Teaching Scholars Program

To date, six teaching scholars have completed the program (1992-93) and 12 are currently in it. Of these 18, eight are female. The ethnicity distribution is six African-American; five Asian-American; one Filipino; and six Caucasian. Of the five who have graduated, three are in medical school, one is in a Science Education graduate program, and one is enrolled in the Teach for America program and is teaching at a secondary school in Baltimore. One of the teaching scholars, who plans on a teaching career at the university level, commented that her experience in the program "...strengthened my desire

to teach". Other comments include "... teaching is not easy...(but)...the feeling I get when students finally learn something makes up for all the hard work" and "...(the experience has led me)...to consider teaching as part of my future in the medical profession".

Teacher-training Course

Final overall course evaluations averaged 4.0/Good (on a 1/Poor ---> 3/Average ---> 5/Excellent scale). The following comments suggest that the participants perceived the course to be relevant: "After working in the lab and taking the teaching seminar, I felt better prepared to teach the modules in the (introductory) lab"; "I would definitely recommend the program and course to anyone who plans to pursue a career in teaching or anyone who would like to TA a biology course"; and "The class gave me a whole new outlook on teaching. We were taught how to engage student interest and how to encourage them to become active learners".

CONCLUSIONS AND RECOMMENDATIONS

Both the anecdotal and quantitative evidence presented in this paper point to successful outcomes of the three interrelated approaches: restructuring of the lab course; using undergraduates to develop experiments for the course; and having these undergraduates participate in a teaching workshop to prepare them for co-teaching the course. It is too early to determine

whether these programs do lead to an increased number of molecular biologists in research or teaching, but the increased enrollments referred to above suggest that exposing students to problem-solving experiments early in their academic careers piqued their interest in both molecular biology and independent research. Thus, these programs may serve as models for other schools, including those, such as Pomona College, that have molecular biology curricula with upper-level research oriented courses (Telzer, 1994).

Although staff and financial resources are not available to maintain the full semester teacher training course on a permanent basis, several recent spin-offs suggest that the project will continue to have impact even after the laboratory development and piloting phases are completed. At the start of the 1993-94 academic year, the authors offered a three-hour session focused on constructivist learning theory and collaborative learning strategies for all new biology teaching assistants.

Additionally, one of the authors has been asked to run campus-wide sessions on these topics in the spring and again for a campus-wide teaching assistant training session to be offered at the end of the summer 1994. As both of these are envisioned as annual events, the original course development work has led to important side effects that reach beyond the biology department.

REFERENCES

Fogle, T. A. (1985) Student-directed biology lab investigations. Journal of College Science Teaching, 14(4), 345-348.

Johnson, R. T., Johnson, D. W. and Smith, K. A. (1990) Cooperative learning: an active learning strategy for the college classroom. Baylor Educator, 15(2), 11-16.

Lumsden, A.S. (1993) Training graduate students to teach. The American Biology Teacher, 15(4), 233-236.

Martin, P. F. (1993) An independent enzyme investigation suitable for use in a large introductory laboratory. Abstract #20. In: Strategies for teaching the life sciences to undergraduates. Proceedings of the 3rd Conference of the Coalition for Education in the Life Sciences, Marine Biological Laboratory, Woods Hole, Mass.

Oliver, J. S. and Simpson, R. D. (1988) Influences of attitude toward science, achievement motivation, and science self concept on achievement in science: a longitudinal study. Science Education, 72(1), 143-155.

Paldy, L. (Ed.) (1989) Report on the NSF workshop on undergraduate biology education. Journal of College Science Teaching, 19(2), 74-81.

Posner, H. B. and Markstein, J. A. (1994) Cooperative learning in introductory cell and molecular biology. Journal of College Science Teaching, 23(4), 231-233.

Shuell, T. J. (1987) Cognitive psychology and conceptual change: implications for teaching science. Science Education, 71(2), 239-250.

Smith, M. U. (1991) Teaching cell division: student difficulties and teaching recommendations. Journal of College Science Teaching, 21(1), 28-33.

Telzer, B. R. (1994) Designing a research-oriented concentration in molecular biology at a liberal arts college. Journal of College Science Teaching, 23(4), 240-243.

Wineke, W. R. (1991) The freshman year in science and engineering. Journal of College Science Teaching, 20(5), 277-287.

ACKNOWLEDGMENTS

The authors wish to thank Prof. Anna Tan-Wilson for valuable advice, Prof. James Dix for developing the software for the enzyme module, and Mr. Mark Smith for administering and analyzing the questionnaires. This work was supported by a grant to Profs. Posner and O'Brien from N.S.F. (#USE-9156253) and a grant to Profs. Tan-Wilson, Posner and O'Brien from the Howard Hughes Medical Institute.

CLASSROOM MAPPING: A REFLECTIVE TOOL FOR THINKING ABOUT CLASSROOM TECHNOLOGY

Landra L. Rezabek

University of Wyoming

and

Deborah M. Floyd

Thomas College

INTRODUCTION

A teacher's educational philosophy can be defined as the expression of what is believed and held to be true in regard to the teaching and learning process. This philosophy is manifested in actions, behaviors, language, and other overt, observable ways. For example, observing the arrangement of a teacher's classroom can suggest much about her/his educational philosophies and values.

Kohl (1969) suggested that "the placement of objects in space is not arbitrary and rooms represent in physical form the spirit and soul of places and institutions. A teacher's room tells us something about who he (sic) is and what he (sic) is doing" (Kohl, 1969, p. 35). Of course, a classroom also reflects, on direct and

symbolic levels, a teacher's views of teaching and learning (Cohn, Kottkamp and Provenzo, 1987; Provenzo and Wolfe, 1974).

A stereotypical view of a teacher is that of a learned person disseminating information. The main activity in such a learning environment involves the teacher telling students what they need to know (Jacobsen, Eggen and Kauchak, 1993). On a direct level, this philosophy may be reflected by a teacher arranging the classroom with straight rows of desks facing toward the preeminent teacher's desk located at the front of the room. If this straight-row arrangement precludes students from seeing and conversing appropriately with each other, analysis of the classroom arrangement on the symbolic level would suggest that the teacher does not value class discussion or interaction.

Recently, the teacher's role has shifted to that of a supporter, facilitator, and coach as well as a creator and organizer of learning environments. If a teacher believes that learning involves the active engagement of students in constructing their own knowledge and understanding through interaction with and support from "the world of people and objects and through the use of technology of many kinds" (Sheingold, 1991, p.18), a teacher may be especially interested in arranging a physical learning environment conducive to these goals and in providing a variety of learning resources for students.

Technological innovations such as videotapes, laser discs, and audio recordings provide teachers with electronic resources to develop classroom learning environments. In the context of this paper, the term

technology, and its related derivatives, is used interchangeably with the term electronic learning resources. Both terms, narrowly defined herein, refer to equipment such as television sets, cassette tape players, and film projectors as well as the materials and programs presented using the equipment.

The physical presence and the organization of electronic resources in the classroom can provide insight into preservice teachers' thinking about technology and the role electronic resources play in the teaching and learning process. In addition, requiring preservice teachers to commit to paper their ideas regarding the presence and organization of electronic resources can be a very effective instructional strategy for encouraging them to reflect on their educational philosophies and biases.

Objectives of the Study

This study investigated a group of preservice teachers' thoughts regarding classroom technologies. They were asked to reflect on what their personal philosophies of teaching and learning were, and then to imagine and form mental images of what their ideal classroom would be like, based upon their personal philosophies. They were then requested to visually represent their thinking on paper by completing a map of their ideal classroom.

The objectives of this study were to: 1) determine preservice teachers' perceptions of the electronic learning resources that they would include in their ideal

classrooms; and 2) examine the distribution and placement of these electronic learning resources. In addition, the teachers' classroom maps themselves were examined to determine the general quality of the visual responses to the task and to look for patterns indicating potential uses of electronic learning resources and implications for classroom interaction.

METHOD

Subjects

The participants in this study were education majors enrolled in undergraduate elementary education programs at two major state universities in the southeastern United States during the 1990-91 and 1991-92 academic years. A sample of 106 preservice teacher education majors, including 69 white females, 29 black females, 5 white males, and 3 black males participated in this study. Participants ranged from 19 to 25 years of age. These preservice teachers possessed a variety of knowledge and experience with the use of electronic learning resources.

Procedure

The preservice teachers in this study were presented with a floor plan of a rectangular classroom showing only a door and a chalkboard appearing on the outline. Participants were asked to think about and then

to draw or visually represent a floor plan of their ideal classroom. Participants were instructed to include as much or as little detail as they felt necessary. There was no prompting by the instructor or discussion of ideas during this data collection period.

The ensuing classroom maps were analyzed to determine the presence and types of visual representations depicting electronic learning resources in the ideal classrooms. Data were triangulated and coded by category of the technology represented.This coding process included frequency counts for the learning resources represented in the classroom maps. No attempt was made to count individual units or numbers of the specific learning resource represented. For example, if six computers were drawn on the map, one tally mark was recorded in the computer category, not the actual number of individual computers that appeared on the map.

The analysis included an examination of the types of electronic learning resources represented, as well as identification of the location of the majority of the learning resources within the classroom. Since preservice teachers may have cited multiple learning resources on their classroom maps, percentages cited in this study total more than 100%. Non-electronic learning resources were excluded from the study.

RESULTS

Of the 106 preservice teachers in this study, 75% (n=80) included electronic learning resources in their ideal classroom maps. About 25 per cent of the participants included no electronic learning resources of any kind.

The most often cited electronic learning resource was the computer. Seventy-seven persons included the computer as an electronic learning resource; this number represented 96.2% of those who included electronic learning resources of some type. Participants' responses in this category included personal classroom computers, printers, computers designated for teacher's use, and computer supplies.

The second most often cited electronic learning resource in the classroom was video technology. Twenty five of the teachers included video equipment in their classroom maps; this number represented 31.2% of those who included electronic learning resources of some type. The video category included responses that represented video images, either live or taped, and monitors to display video signals. This category also included references to broadcast, cable, or closed-circuit television and also videotape technology.

The third most frequently cited type of electronic learning resource was audio media. Eighteen (17.0%) included some type of audio equipment; this number represented 22.5% of those participants who included electronic learning resources of some type. Types of audio media included tape recorders and audio tapes,

record players and records, and headsets. This category included only audio resources described as hardware or software and excluded areas termed "listening centers", since this is a general term which can refer to areas for conversation or dialogue as well as areas in which electronic equipment is available.

In addition to these three primary technologies cited by the preservice teachers, various other electronic learning resources were mentioned as well. Responses tabulated in the miscellaneous category included projection screens, overhead projectors, and a diverse array of other technologies such as telephones, film, "multimedia" and interactive video.

Distribution of Learning Resources

As mentioned above, 75% of the 106 preservice teachers responding to this study included electronic learning resources in their classroom maps. Approximately 70 per cent of these respondees indicated the resources would be positioned around the perimeter of the classroom. The remaining thirty per cent indicated the learning resources would be distributed throughout the classroom.

DISCUSSION

If, as Kohl (1969) stated, the physical organization of a teacher's room tells us something about her/his philosophies regarding teaching and learning, then the classroom maps produced by these preservice teachers

provide us with a glimpse into their thinking about electronic learning resources and their role in the classroom. Three-quarters of all preservice teachers participating in the study included electronic learning resources in their classroom maps. These resources consisted primarily of computers, video, and audio media which would be located primarily around the perimeter of the classroom.

At first glance, the data are encouraging and appear to indicate an awareness on the part of preservice teachers that computers, video, and audio media are desirable elements in the classroom. However, these figures must be balanced with the knowledge that nearly one-quarter of the preservice teachers included no electronic resources whatsoever on their classroom maps.

In addition, results of the study in no way can be taken to indicate that the same number of preservice teachers who **identify** classroom technologies on their maps would actually **use** these electronic resources during instruction. Nor can it be assumed that their students necessarily would do so. Tremendous gaps may exist between awareness of the availability of electronic resources and their actual integration into classroom use.

It is imperative that teacher educators not only continue to be concerned about preservice teachers' awareness of classroom technologies, but that they also actively support the integration of electronic learning resources in classrooms. This support may take any number of forms -- from placing interning teachers in situations where mentor teachers use electronic learning resources to requiring preservice teachers to develop and

deliver lessons that integrate technology during methods courses and intern experiences.

Another disconcerting fact arising from the study is that the richness of electronic resources varied greatly. The classroom maps themselves indicate a great disparity among those preservice teachers who identified any type of electronic learning resource, and responses of the 80 students who included electronic learning resources varied greatly in terms of the numbers and types of technologies identified. Preservice teachers may have a proclivity to identify electronic resources with which they feel most comfortable or knowledgeable, or they may merely be including the technologies which they have heard about and feel somehow obligated to identify. This is an area for further study.

The finding that the majority of preservice teachers who identified electronic learning resources placed them around the perimeter of the classroom is hardly surprising knowing that typical classrooms have power sources around the classroom walls and only in rare cases in the interior of the room. It is interesting to muse that traditional architectural constraints rather than educational philosophy may influence how preservice teachers organize and arrange electronic resources. This architectural obstacle may add a new dimension to Kohl's (1969) contention that classrooms operate on direct and symbolic levels. If teachers do value electronic resources and wish to make them an integral part of the teaching and learning environment, they may be confronted with physical barriers to the actualization of their educational philosophies.

IMPLICATIONS FOR TEACHING AND LEARNING

These data provide some considerations for the preparation of preservice teachers. Exposure to educational technologies in college and university teacher education programs may be essential if preservice teachers are to develop an awareness of the electronic learning resources available to them and to their students.

On one level, preservice teachers must be provided opportunities to learn about and practice using existing technological support for teaching and learning. As discussed above, preservice teachers also must be provided with guidance in learning to integrate these resources into their classrooms in support of their educational philosophies.

Since the old adage "we teach as we are taught" still appears to be true, preservice teachers must also be provided with technology-using faculty members who serve as role models and mentors. This latter factor influencing preservice teachers' use of electronic learning resources presents a great challenge to teacher education programs whose faculty members may not themselves be comfortable or facile with the opportunities presented by educational technologies.

Just as college faculties' feelings about technology may increase or decrease the likelihood that they will incorporate technology into their teaching, similar feelings and beliefs most probably influence the actions

of preservice teachers. Visualizing their ideal classroom provided a vehicle for preservice teachers to "put some of these feelings on the table" as they engaged in both professional and personal reflection in the preparation and completion of the assignment and during follow-up classroom discussions.

Assigning the production of a visual representation of an ideal classroom was in itself a successful aspect of the classes in which the activity was included. Students found that visualizing their thoughts and philosophies by reflecting them in a classroom map was a valuable exercise.

One preservice teacher who had been required to draw a classroom map at the beginning of her program also voluntarily completed a map at the end of her two-year program of study. The first map depicted straight rows of chairs facing toward the teacher's desk; the second map showed student desks grouped together and the teacher's desk in the corner. During conversations, the preservice teacher emphasized how her educational philosophy had changed over the semesters and that the most current classroom map demonstrated her interest in cooperative learning groups and the role of teacher as facilitator and mentor. The student chose to include these two classroom maps in her professional portfolio to show her growth and development as a teacher.

In conclusion, the use of classroom mapping proved to be an effective instructional strategy. The process encouraged reflective thinking about preservice teachers' philosophies and beliefs regarding the process of teaching and learning.

REFERENCES

Cohn, M. M., Kottkamp, R. B., and Provenzo, E. F., Jr. (1987) To be a teacher. New York: Random House.

Jacobsen, D., Eggen, P., & Kauchak, D. (1993) Methods for teaching. New York: Merrill.

Kohl, H. (1969) The open classroom: a practical guide to new ways of teaching. New York: Random House.

Provenzo, E. and Wolfe, M. (1974) The physical setting and open education. School Review, 82, 557 - 574.

Sheingold, K. (1991) Restructuring for learning with technology: the potential for synergy. Phi Delta Kappan, 73(1), 17 - 27.

Portions of this paper have been published by the International Visual Literacy Association (copyright 1994), and are used by permission.

ASSESSMENT ON THE MOVE

Nick Rushby

PA Consulting Group

Sundridge Park

INTRODUCTION

The PA Consulting group and British Rail are carrying out a pilot study, sponsored by the Department of Employment, to demonstrate how Personal Digital Assistants (PDAs) can function as efficient, cost-effective job aids for supervisors carrying out workplace assessment. This work is linked to a broader PA-supported project to restructure the whole of the training system for British Rail signal and telecommunications staff to improve safety and effectiveness.

The implications for wider use of PDAs are immense. The study addresses a problem which faces all organizations seeking to implement vocational qualifications for their employees. It is attracting increasing interest from a number of commercial organizations which face similar problems in carrying out workplace assessment. It is also starting to find applications in education. Beset with bureaucratic assessment procedures, teachers and administrators are

now beginning to see the potential for more cost-effective assessment processes.

Background

At one time, training was focused on content and delivery. Credit was given for going through a training course and (perhaps) passing an end of course test. Now it is more important for a person to demonstrate competency to do something, rather than to demonstrate how s/he had acquired that competence -- or even whether any formal education or training had been involved in the process.

Competence is defined as the ability to perform work roles or jobs to the standard required in employment. In the United Kingdom, it forms the basis for a panoply of national occupational standards -- and associated vocational qualifications. There are now over 160 lead bodies in the UK developing sets of occupational standards for managers and accountants, for trainers, for manufacturing industries and engineering, and for railway staff.

How can a competent person be recognized? Specifically, competence is that which is demonstrated by people who are successfully carrying out all the activities associated with their jobs. The answer is, therefore, that we must see persons carrying out those jobs in the workplace and determine when they are carrying them out successfully. Thus, the sets of occupational competences consist of elements of competence, each with criteria for the performance that must be achieved.

Safety Critical Work on British Rail

Following a major disaster (the Clapham Rail Disaster), the ensuing report drew attention to the need for a complete overhaul of the training provisions for signal and telecommunication staff. Competence based training was seen to be the key to compliance with such recommendations. The move to competence based training and vocational qualifications is an objective set by the British Rail Board and contributes to the Board's personnel policy. Crucially, in order to comply with UK and European law, railway operators must not allow any person to undertake safety critical work unless that person is competent and fit.

The flexible approach to training is expected to halve the resources required for training and make it possible to provide the level of training required in order to have safe, competent staff. The new training system being developed by the British Rail with support from PA Consulting Group is firmly based on the tenets of competence and workplace assessment. It is linked to the occupation standards being developed by the Railway Industry Training Council and to the achievement of vocational qualifications.

The system specifically addresses the training needs of about 7000 signal and telecommunications technicians. The methods and approaches are already being extended in support of the training of a further 20,000 civil engineering staff and 7,000 mechanical and electrical technicians.

The process of workplace assessment in signal and telecommunications presents problems because of: 1) the hostile environment (often wet, dark and inherently dangerous); 2) the complexity of the competences and performance criteria required, not only for assessment with respect to vocational qualifications, but also to enable the Railway operators to be assured that their staff are competent in many safety critical tasks; and 3) the unpredictability of what tasks may be observed during a working shift.

The PA Group's expectation of workplace assessment of British Rail signal and telecommunications technicians is that the supervisor may have some intention of assessing a specific competence -- for example in fault finding on a specific piece of equipment -- but that the reality in the workplace is that things will change and this task will not be required.

As an example, knowing that one person in a three man fault team is not yet competent in fault finding and repairing a specific kind of level crossing barrier, the supervisor checks the relevant performance criteria and joins the fault team. Unfortunately, that night there are no faults of that kind. However, the team is called out to a fault on a certain type of point machine. The supervisor is not sure whether the person in question has already displayed his competence on that point machine -- or whether it is important to him and his employer that he is competent to repair it.

There are many different types of equipment on British Rail, and this is one of about 1000 equipment specific competences that the operators require of their signal and telecommunications staff if they are to run a

safe railway (as they are required to do by law). The supervisor's task is further complicated by trying to recall the 20 or more performance criteria that relate to that competence. Since he or she did not know they were going to observe the competence, there was no chance to prepare.

It is night and the rain is being driven by the wind. It is a 15 minute walk from the van along the ballast beside the track with trains travelling at 125 mph passing every few minutes. Recording sheets are reduced to pulp in seconds and the little pink boxes on the form are invisible in the torch light. Yet, the worker is displaying the workplace competence that should be recorded so that his employer knows he is safe to work on this specific equipment and so that eventually he can be awarded his next vocational qualification. It may also be helpful (so that the Railway operators have a continuing assurance of safe working) to record whether a previously observed competence is no longer present -- that is, whether the individual is now failing to display the competences displayed previously and so should now be assessed as not competent.

PDAs AS JOB AIDS

PA Consulting Group's clients are interested in any technique which can give real business benefit. About ten years ago, a team began looking seriously at mobile computing devices and the impact that they could have

on the way that people handle information. As the pace quickened towards the development of personal digital assistants (PDAs), the group was interested to see whether they had any significant business applications and -- the findings were that they do.

Perhaps the best known PDA is the Apple Newton MessagePad, a pocket sized device capable of running serious applications programs such as the system for workplace assessment -- as well as offering the facilities of an electronic organizer. Instead of a keyboard, the user writes on the screen with a pen. The Newton can recognize handwriting or marks in boxes on the screen, and can access large amounts of information held in its internal memory or on slot in memory cards.

It was surmised that the problems of workplace assessment might be overcome by using PDAs to hold records of unobserved competences, and act as job aids for supervisors guiding them through the performance criteria associated with each competence. These PDAs would check on the consistency of the data and would subsequently transfer the details of the competences of individual technicians to a central training management system.

The objective of the current study was to determine, and perhaps ultimately demonstrate if PDAs could function as an effective -- and cost effective -- job aid for the purpose of assessment in the workplace. The broad goal is for a robust hand-held device that will hold records of unobserved competences, and act as job aids for supervisors guiding them through the performance criteria associated with each competence. The device will check the consistency of the data and will subsequently

transfer the details of the competences of individuals (in the first instance, British Rail signalling technicians) to a central management system. It is anticipated that the use of handwriting recognition will be minimal and that most entries will be by picking a box on the screen. Disparities and unexpected results will be queried and confirmation will be sought from the user.

The characteristics of a number of PDAs were reviewed and the Apple Newton MessagePad stood out for three principal reasons: 1) it was immediately attractive to use and had the most intuitive interface -- critical in gaining user acceptance and in minimizing support costs; 2) the object oriented software toolkit allowed very rapid prototyping and reuse of software components (experience in developing applications indicated that this minimized the effort required to set up an operational system which could be easily modified and updated -- the valuable software investment thus protected); and 3) it was believed that this toolkit would become an industry standard and allow the building of libraries of software objects which could be exchanged and used to construct larger applications.

Apple originated the term PDA, is investing several million dollars in promoting Newton technology world-wide, and is committed to establishing it as an industry standard. Of all suppliers, Apple was judged to be the most committed to producing a long term technology base that would be sufficiently stable to protect investment in software applications.

OTHER APPLICATIONS IN TRAINING AND DEVELOPMENT

The railway is just one example of an environment in which staff engaged in safety critical work must be able to demonstrate their competence. There are many other organizations with similar needs. Assessors and verifiers working in more benign environments (for example in management and in the leisure industry) have also expressed keen interest in the possibility of a practical and convenient job aid to support workplace assessment.

The PA staff is now exploring the addition of limited intelligence to PDAs to support their use in advising on programs for personal development. The real benefit will come when continual assessment of competence becomes an integral part of the manager's or supervisor's life -- and the means of handling that assessment is through technology which also meets a variety of everyday needs.

Acknowledgements

The project to study PDAs as job aids for workplace assessment is supported by the UK Employment Department and British Rail. The author would like to thank colleagues Bob Fairbrother of British Rail and Geoff Vincent and Ian Roberts of PA who are working with the author on this specific project.

TEACHING TO ENHANCE CREATIVITY – BASIC CONCEPTS

Dorothy A. Sisk

Lamar University

INTRODUCTION

The last forty years represent rapid development of methods and techniques to stimulate creative thinking (Adams, 1978; Covington, et. al., 1974; Davis and Scott, 1978; de Alencar, 1993; de Bono, 1968; Ellsworth and Sindt, 1994; Feldman, 1993; Jacoby, 1993, Koberg and Bagnall, 1976; Levenstein, 1965, Luthe, 1976, Maker, 1993: Nickerson, et. al, 1985; von Oech, 1983; Parnes, 1967; Phillips, 1994; Stein, 1974; 1975; Van Gundy, 1981). Osborn (1959) and Parnes (1967), early leaders in the Creative Education Foundation (CEF), had a powerful influence on the awareness of creativity and the need for creativity training. CEF sponsors an annual Creative Problem solving Institute in Buffalo, N.Y. Guilford (1967), a former colleague of CEF, also had remarkable influence on the development of assessment techniques based on his theoretical model, the Structure of Intellect. Guilford's work was the stimulus for Torrance's (1965) development of the Torrance Test of Creative Thinking.

Techniques to stimulate creative thinking and problem solving are referred to as applied creativity (Hermann, 1989). Brainstorming (Osborn, 1959), morphological analysis (Prince, 1982) and synectics (Gordon, 1959), are examples of techniques to help individuals or groups generate creative solutions and develop their creative thinking skills.

Creative thinking skills include patterns of association, fluidity and flexibility of ideas, that are often outside the ordinary thinking of most people. Whether creative thinking skills are habits developed from early experiences or represent inherent differences in thinking has not been established. Classic studies by Schaefer-Simmern (1948) in which individuals were exposed to artistic performance in intensive training reveal that some subjects perform at a high quality level and others do not. These studies pose the question of creative ability hinging more on what one does with talent over time. Complex forms of creativity, such as the solution of scientific problems, writing of novels and synthesis of theoretical positions, grow out of momentary inspiration, but they also require organization of ideas, structuring of concepts, hard work and high motivation.

There are many forms of creativity. Creativity results in tangible products such as invention, scientific theories, musical compositions, poems, sculpture, paintings and dance. Creativity is also concerned with the generation of new and applicable responses to daily challenges, personal growth, effective coping and personality integration and effective coping (Shallcross and Sisk, 1989; Sternberg, 1985; Treffinger, 1986).

The literature on creativity identifies factors that further creative production: talent and natural endowment, expertise and education, self confidence, divergent production, ability to work with many types of techniques, leisure, self denial, persistence, patience, playfulness, and inner tension (Getzels and Csikszentmihalyi, 1976; Getzels, 1964; Resnick 1976; Wallach 1976). Societal factors also impact on creative production and these include: individual autonomy, minimal economic well being and opportunities for action. (Gardner, 1983; Sternberg, 1985).

This article presents a working definition of creativity and twelve suggestions for college and university educators to assist students in developing personal and productive creativity. Creativity is conceptualized as a vital and necessary component of the teaching/learning process.

WORKING DEFINITION OF CREATIVITY

A working definition of creativity includes four aspects: 1) person; 2) process; 3) product; and 4) environment. This definition provides a framework in which to examine teaching to enhance creativity. In this definition, the person uses processes to generate a product within a creative environment that enhances creative production.

TEACHING TO ENHANCE CREATIVITY-

BASIC CONCEPTS

The four aspects of creativity synergistically interact. Klein (1982), asked highly creative people, including novelists, poets, musicians and social scientists to describe their creativity. Using the same process, Sisk (1994), surveyed participants at a Creative Problem solving Institute in Buffalo, New York. The words used to describe their creativity are listed in Table I below.

TABLE 1. Words Used To Describe Creative Behavior

Well Known Creative People		Creative Professionals	
Humility	Energy	Inventive	Initiator
Courage	Perseverance	Design	Improvisor
Self Discipline	Craftsmanship	Divergent	Doer
Curiosity	Spontaneity	Open	Tinkerer
Observation	Trusting	Humor	Dreamer
Freedom	Patience	Persistence	Optimistic
Serendipity	Inspiration	Self Directed	Risktaker
Shy	Alert	Discoverer	Defer Judgment
Egotism	Expanding consciousness	Courage	Mission
Imagination	Compassion	Unusual	Responsive
Self Sacrifice	Original	Imaginative	Perceptive
Concentration	Order from Chaos	Intuitive	Affective
Humor	Irrationality	Visionary	Action Oriented
Sensitivity	Expressive	Implementer	Motivated
	Credibility	Initiator	Detail Person

The lists are somewhat different, but there is similarity in the terms used to describe creative behavior. Twelve suggestions based on these selected characteristics of creative behavior are offered for teaching to enhance creativity.

Suggestions for Teaching to Enhance Creativity

1. Creative people are optimistic. Faculty need to model an optimistic point of view in interactions with students. One technique practiced at the Creative Problem Solving Institute in Buffalo, New York, is to ask, "What's good about it?". This technique can be particularly useful to elicit positive reactions to situations normally having strong negative affects.

2. Creative people take in details. In classroom discussions, faculty can encourage students to become itemizers and take in as much detail as possible. An example of encouraging such thinking is to ask students to magnify, minify, simplify, adapt and substitute ideas.

3) Creative people are risk takers. A story in leadership circles that illustrates being a risk taker involves Tom Watson, Jr., former CEO of IBM. He was approached by a young engineer from IBM, who stated that he had a great idea, but that his Middle Manager had said it was stupid and his co-workers had said that it would never work. However, the engineer firmly believed that it would work. Watson thought for a moment and then asked the engineer how much money he would need to

develop the idea. The engineer replied, $50,000. Watson authorized the money. Several weeks later, the young man returned and sadly handed him a letter of resignation. "It didn't work," he said. Watson looked at him, then tore the envelope into pieces and said, "Why should I accept your resignation, after I just spent $50,000 to train you?".

In interactions with students, faculty need to encourage risk taking and to be supportive.

4. Creative people use multiple points of view. Multiple points of view can be enhanced by including speakers and information from a variety of disciplines and ethnic groups.

5. Creative people make time for themselves. Journals can help students learn to make time for themselves. Have them divide the journal into two sections, one for class work and one for personal activities. Students can list goals in both categories, including accomplishments and obstacles. Keeping a journal on a regular basis helps students realize when their lives are out of balance.

6. Creative people defer judgment. Judgments are high speed comparisons created by insecurity, or as Barker (1993) refers to them, "hardening of the categories", or mindsets that block understanding. In small groups, ask students to think of times in which they were judged or may have judged someone. Ask them to discuss how it felt and to disengage judgment, since it blocks creativity.

7. Creative people seek inspiration and develop a mission. Instructors need to be alert to stories that demonstrate creativity such as Kekule, the scientist who in a state of repose, gazed into a fire and visualized snakes tumbling in a ring. From that vision, he conceptualized the theory of the benzene ring. Encourage students to share stories that they have heard or experienced. Stories enliven discussions, personalize learning and offer opportunities for students to become more passionate about their learning.

8. Creative people are responsive. Encourage students by using empathetic expressions. Encourage students to view conversation as a tennis game and to hit the ball back to the sender.

9. Creative people are perceivers. Promote the acceptance of intuition as a legitimate form of knowing. Help students listen to their unconscious and to rely on their senses, touch, taste, smell, sound and sight. Use multisensory teaching strategies and incorporate technology to address the senses. Provide a behavioral outlet by encouraging students to get up and move around. In small groups, students can experience sociodrama and simulation and engage in behavioral learning.

10. Creative people are affective. Encourage your students to accept basic drives and instincts as part of human nature. Use empathetic understanding to relate interpersonally. Help students to develop a system of

valuing, prizing and cherishing. Encourage them to share their affective side, as they pursue their cognitive studies. Encourage experiences that bring the thrill of the unknown.

11. Creative people are intuitive. Encourage students to respond intuitively by using stimuli, such as pictures, to create a group or individual story. Ask students to identify the key concept of the story. Then, ask them to describe how they feel about the story. Finally, ask how they can apply or adapt this information to personal or professional experiences.

12. Creative people are action oriented. Employ the "do it" principle to encourage student action. Creative behavior is an active process requiring curiosity, awareness, initiative and risk taking. Arriving at a fixed point is not the purpose of the process. Instructors should encourage students to explore, to experiment, to expand options and to move from previously set boundaries.

ASSESSMENT OF CREATIVITY

Tests for creative thinking are usually group administered. The focus is on how well students solve problems and use their imaginations. Tests may be verbal or figural, some require drawing activity; however, drawing skill is not being tested. Paul Torrance (1972), a

leading scholar in the field of creativity, uses product improvement as one of several exercises.

Other typical activities called for in tests of creative thinking are exemplified by the following:

1. Describe all the uses for a simple object such as a brick.

2. Here are six pictures. How well can you connect them to tell a story?

3. A man comes out of a plane with a bulging briefcase. He has a worried expression on his face. Write down everything you can about the person that makes a connection between what he is carrying and his state of mind.

Each of the above items are scored for fluency, flexibility, originality, and elaboration. Although these questions require written responses, spelling, grammar, and punctuation are not important. There are no right or wrong response; however, some solutions will be more detailed and complex, and offer more surprises than others. These are the factors upon which Torrance's scoring system is based.

CONCLUSIONS

It was once believed that creative behavior just happened. Now it is accepted that creative behavior involves skills, and that these skills improve with practice. It is also accepted that a disposition toward creativity is an asset in developing personal or productive creativity. Faculty interested in developing the creativity of students need to provide adequate structure, motivation, opportunities for involvement, practice and interaction with others. Motivating and facilitating conditions in the classroom will make a difference in the amount and level of creative functioning in students, and these differences are greatest and most predictable when deliberate creative teaching and practice are employed.

REFERENCES

Adams, J. L. (1978) Conceptual blockbusting: a pleasurable guide to better problem solving. New York: Norton.

Barker, J. (1993) Futures edge. New York: Morrow.

Covington, M. V., Crutchfield, R. S., Davies, L. B., Olton, R. M. (1974) The productive thinking program. Columbus, OH: Merill.

Davis, G. A., and Scott, J. A. (1978) Training creative thinking. New York: Holy, Rinehart and Winston.

de Alencar, E. M. (1993) Thinking in the future: the need to promote creativity in the educational context. Gifted Education International, 9(2), 93-96.

de Bono, E. (1968) New think. New York: Basic Books.

Ellsworth, P. C., and Sindt, V. G. (1994) Helping "aha" to happen: the contributions of Irving Sigel. Educational Leadership, 51(5), 40-44.

Feldman, D. H. (1993) Child prodigies: a distinctive form of giftedness. The Gifted Child Quarterly, 37(4), 188-193.

Gardner, H. (1983) Frames of mind: The theory of multiple intelligences. New York: Basic Books.

Getzels, J. W. (1964) Creative thinking, problem solving and instruction. In E. R. Hilgard (Ed.), Theory of learning and instruction, sixty-third yearbook of the National Society of the Study of Education, Part I. Chicago: University of Chicago Press, pp. 240-267.

Getzels, J. W., and Csikszentmihalyi, M. (1976) The creative vision: a longitudinal study of problem finding in art. New York: Wiley.

Guilford, J. P. (1967) The nature of human intelligence. New York: McGraw-Hill.

Gordon, W. J. J. (1959) Synetics. New York: Harper & Roe.

Herrmann, N. (1989) The human brain. Lake Lure, NC: The Herrmann Group.

Jacoby, P. (1993) Unlocking your creative power. San Diego: Ramsey Press.

Klein, R. (1982) An inquiry into the factors related to creativity. The Elementary School Journal, 82(3), 256-265.

Koberg, D., and Bagnall, J. (1976) The universal traveller: a soft-system guide to creativity, problem-solving, and the process of reaching goals. Los Altos, CA.: W. Kaufmann.

Levenstein, A. (1965) Use your head: the new science of personal problem solving. New York: MacMillan.

Luthe, W.L. (1976) Creativity mobilization technique. New York: Grune and Stratton.

Maker, J.C. (1993) Creativity, intelligence, and problem-solving: a definition and design for cross-cultural research and measurement related to giftedness. Gifted Education International, (9)2, 68-77.

Nickerson, R. S., Perkins, D. N., Smith, E. E., (1985) The teaching of thinking. Hillsdale, NJ: Lawrence Erlbaum Associates.

Osborn, A. F. (1959) Applied imagination. New York: Charles Scribners.

Phillips, D. R. et. al. (1994) Beans, blocks, and buttons: developing thinking. Educational Leadership, (51)5, 50-53.

Parnes, S. J. (1967) Creative behavior guidebook. New York: Scribners.

Prince, G. (1982) Synetics. In S. A. Olsen (Ed.) Group planning and problem solving method in engineering. New York: Wiley.

Resnick, L. B. (1976). Changing conceptions of intelligence. In L. Resnick (Ed.), The nature of intelligence. New York: Wiley, pp. 1-10.

Schaefer-Simmern, H. (1948) The unfolding of artistic activity: its basis, processes and implications. Berkeley, CA: University of California Press.

Shallcross, D. and Sisk, D. (1989). Intuition: an inner way of knowing. New York: Bearly Limited.

Stein, M. I. (1947) Stimulating creativity, Vol. I.: individual procedures. New York: Academic Press.

Stein, M. I. (1975) Stimulating creativity, Vol. II.: group procedures. New York: Academic Press.

Sternberg, R. J. (1985) Beyond IQ: a triarchic theory of human intelligence. Cambridge: Cambridge University Press.

Torrance, E. P. (1965) Rewarding creative behavior: experiments in the classroom creativity. Englewood-Cliffs, NJ: Prentice-Hall.

Torrance, E. P. (1972) Torrance tests of creative thinking. Bensenville, Illinois: Scholastic Testing Service.

Treffinger, D. J. (1986) Research on creativity. The Gifted Child Quarterly, 30(1), 15-19.

VanGundy, A. B. (1981) Techniques of structured problem solving. New York: Van Nostrand.

von Oech, R. (1983) A whack on the side of the head. Menlo Park, CA: Creative Think.

Wallach, M. A. (1976). Tests tell us little about talent. American Scientist, 64.

THE GLOBAL CONNECTION CLASSROOM PROJECT

David E. Smith

and

Steven L. Yamshon

National University

INTRODUCTION

Despite its serious flaws, the lecture is still the most widespread teaching method (Specht, 1985). Will more creative methods be found that take account of students' autonomy and individual learning styles? What methods can be used to achieve active participation by students in formulating their own learning objectives and creating new methods to achieve them?

Current literature abounds with journal articles relating to new methods of classroom teaching (Cartwright, 1993). Many of these teaching methods have specific applications in the classroom environment, as a supplement to the lecture, but none can replace the lecture method (Nicastro, 1991).

A special classroom situation exists as we prepare for the University of the 21st Century (Cassivi, 1989). The lecture and other methods of teaching are currently being used successfully in international business classes. However, to immerse students in the concept of the

emerging global economy, new and innovative methods of teaching are required (MacNab and Kamath, 1990). The profile of the student in the 21st Century will be the college or university student who is sophisticated and well-travelled, possessing a broad-based business background and career orientation.

Purpose

The GLOBAL CONNECTION CLASSROOM PROJECT is an innovative teaching method employing new technology for application in the international business curriculum. The purposes are as follows: 1) attract prospective students into the international business curriculum; 2) maintain the student's continuing interest in the subject matter by providing "real-time" learning experiences (Vardi, 1985); 3) retain students for completion of the degree programs by involving them in the learning experience; 4) transfer new technology currently used in the business environment to classroom applications in education; and 5) bridge the gap between countries in the global economy (Gransden, 1994).

METHODOLOGY

THE GLOBAL CONNECTION CLASSROOM PROJECT is currently being used for classroom teaching of international business courses at National University in the School of Management and Technology. The project is a two phase research program which will

incorporate the AT&T Language Line Service and AT&T Video Teleconferencing Service in the classroom environment.

The Language Line Service from AT&T facilitates simultaneous language interpretation in 140 languages to any country worldwide. Language Line Service is a new technology which consists of long distance conference-call telephone service combined with simultaneous language interpretation. Video Teleconferencing Service, also provided by AT&T, uses landlines or satellite transmission for global video teleconferencing.

Phase one of the project, which is being funded by a Presidential Award from National University and with additional support from AT&T, is a feasibility study in which the new technology is employed in the classroom setting, with guest speakers, through worldwide teleconferencing. During this phase, budgets are being refined, and the learning experience of using the new technology and working with the guest speakers will serve as a preparation for phase two of the project, in which full implementation of the technology will take place. During phase one, additional grant proposals have been submitted, seeking research funding for continued implementation during the second project year.

IMPLEMENTATION - PHASE ONE

The program participants are undergraduate and graduate students enrolled in international business courses at National University. The two-year program

began in January 1994 and is funded for the first year. It involves classes at National University Regional Learning Center in Irvine, California.

The concept of the program is to use guest speakers on a worldwide basis to interface with international business classes, utilizing AT&T Language Line Service, and long distance conference-call telephone service.

The guest speakers include university professors and business executives, as appropriate, for the specific academic courses. Arrangements for the guest speakers have been finalized through business and academic networking, as well as through National University Alumni who are foreign nationals returning to their respective countries after graduation.

The selected international guest speakers will serve on a voluntary basis and will contribute their time without compensation, since they all have an interest in the educational aspects of participating and using "state of the art" technology for this classroom teaching application. The following countries are currently being represented with 23 guest speakers: Australia, Belgium, Canada, Denmark, France, Hong Kong, Indonesia, Ireland, Italy, Mexico, Netherlands, New Zealand, People's Republic of China, Puerto Rico, Republic of South Africa, Russia, Singapore, South Korea, Sweden, Switzerland, Taiwan, Turkey, and the United Kingdom.

Set-up and rehearsal times are approximately 30 minutes for each guest speaker. This is accomplished outside of classroom hours. The classroom time with each guest speaker "on line" is 30 minutes. The format is similar to a live interview in which the classroom

instructor serves as the interviewer, to discuss topics of current interest with the guest speaker. The guest speaker, rather than presenting a prepared lecture, provides insights into current business and political trends in her/his country from the perspective of an "insider" and may speak in her/his native language in order to maintain a depth of conversation and relaxed atmosphere. The guest speaker may also speak in English if s/he prefers, without the Language Line Service. These arrangements are made during the setup time.

The following classes are scheduled for participation in phase one of the project:

MKT 430	Introduction to Global Marketing
MGT 430	Survey of Global Business
MGT 631	Global Marketing
MGT 630	Global Business Environment
MGT 637	Comparative International Management
FIN 650	Global Financing for Trade
MGT 685	International Business Project

IMPLEMENTATION - PHASE TWO

Phase two of THE GLOBAL CONNECTION CLASSROOM PROJECT will begin in January 1995. The extent of the project will be determined by the funding. Phase two will expand the technology by

utilizing AT&T Video Teleconferencing Service. The guest speaker concept will be similar. However, political leaders will be used more extensively in this phase. AT&T has a co-marketing agreement with Affinity VideoNet Inc. with video teleconferencing sites at locations in 68 international cities to facilitate the video teleconferencing linkage with National University. Phase two will involve international business classes at the main campus of National University in San Diego, California.

The video teleconferencing classroom facilities at National University will be linked to guest speakers at international locations. During the video teleconferencing, interviews will be conducted in English with no simultaneous language translation, and AT&T Language Line Service will not be employed. This will limit the potential guest speakers; however, the technology is not available for simultaneous language translation and video teleconferencing at this time.

In order to fully maximize the educational opportunities for the project during phase two in the second year, guest speakers will be linked to the classroom setting at National University in San Diego. International business classes at all of the Regional Learning Centers at Irvine, Los Angeles, San Jose, and Sacramento, California, will participate through the existing video teleconferencing distance education network.

During phase two, the project will be expanded through a mentoring process. To gain wider influence and acceptance, other faculty members, involved in the teaching of international business courses at the National University Regional Learning Centers and the San Diego

main campus will be included in the program preparation and implementation.

IMPLICATIONS AND CONCLUSIONS

This two phase project has long-term implications: 1) it will be expanded to other National University Regional Learning Centers; 2) through a mentoring process, other faculty members will be invited to participate in the project; 3) classroom research will be conducted based on the results of the project; and 4) through conference presentations, the concept and model of the project will be transferred to other colleges and universities on a worldwide basis.

During the two years of the project, the long term implications will begin to evolve through classroom research to show the teaching effectiveness and ramifications, as well as the financial viability of using the new technologies in classroom teaching applications.

REFERENCES

Cartwright, G. P. (1993) Teaching with dynamic technologies. Change, 25(6), 67-69.

Cassivi, D. (1989) The education of adults: maintaining a legacy. Lifelong Learning: An Omnibus of Practice and Research, 12(5), 8-10.

Grandsen, G. (1994) Distance education in Russia. The Chronicle of Higher Education, 26 January, A41-42.

MacNab, B. and Kamath, S. (1990) New models for enhancing interactive learning in business schools: Pacific rim marketing-China experience. Journal of Teaching in International Business, 2(2), 61-79.

Nicastro, M. L. (1990) A naturalistic study of interactive learning techniques in business management courses at the collegiate level. Doctoral Dissertation, the Ohio State University, 344-368.

Specht, P. H. (1985) Experiential learning-based vs. lecture-based discussion: the impact of degree of participation and student characteristics on comprehension and retention. Journal of Business Education, 60(7), 283-287.

Vardi, Y. (1985) Experiencing organizational realities in the classroom: a tentative experiment. Journal of Business Education, 60(6), 234-238.

CONTRIBUTORS

FRANK M. BOSWORTH
Dept. of Visual Communication & Technology Education
College of Technology
Bowling Green State University
Bowling Green, Ohio 43404

JACK A. CHAMBERS
Florida Community College at Jacksonville
501 W. State Street
Jacksonville, FL 32202

SHARON J. CONFESSORE
The George Washington University
801 22nd Street, N.W., Suite T-605
Washington, D.C. 20052

JAMES CUNNINGHAM
Dept. of Humanities
Embry Riddle Aeronautical University
600 S. Clyde Morris Blvd.
Daytona Beach, FL 32114

ROBERT A. DESHARNAIS
Dept. of Biology & Microbiology
California State University, Los Angeles
5151 State University Drive
Los Angeles, CA 90032

DAVID ELLIOTT
Center for Distance Learning
SUNY Empire State College
2 Union Avenue
Saratoga Springs, NY 12866

J'ANNE ELLSWORTH
Educ. Specialties
Northern Arizona University
180 S. Coyote Lane
Cornville, AZ 86325

DEBORAH M. FLOYD
Academic Affairs
Thomas College
1501 Mill Pond Rd.
Thomasville, GA 31792

WILLIAM FREED
Dept. of Mathematics & Physics
Concordia College
7128 Ada Blvd.
Edmonton, Alberta T5B 4E4
CANADA

SANDRA GILCHRIST
Division of Natural Sciences
New College of Univ. of South Florida
5700 N. Tamiami Trail
Sarasota, FL 34243

SHAUNA C. GROVELL
The George Washington University
801 22nd Street, N.W., Suite T-605
Washington, D.C. 20052

THOMAS J. HERBERT
Dept. of Biology
University of Miami
P.O. Box 249118
Coral Gables, FL 33124

LARRY M. HOLT
Rollins College Brevard Campus
1535 North Cogswell Street
Rockledge, FL 32955

SHIRLEY A. HUDSON
College of Technical Careers
Faner Hall, Rm. 2031
SIU at Carbondale
Carbondale, IL 62901

OTOLORIN JONES
Center for Distance Learning
SUNY Empire State College
2 Union Avenue
Saratoga Springs, NY 12866

KIMBALL B. KENDALL
Information Technology
Sante Fe Community College
3000 N.W. 83d Street
Gainesville, FL 32606

KATHLEEN KING
Dept. of English & Philosophy
Idaho State University
Pocatello, ID 83209

G. P. P. KUNTZ
Dept. of Mathematics & Physics
Concordia College
7128 Ada Blvd.
Edmonton, Alberta T5B 4E4
CANADA

P.A. KUNTZ
Computer Science & Business
Concordia College
7128 Ada Blvd.
Edmonton, Alberta T5B 4E4
CANADA

LESLIE H. LIGHTBOURNE
University of Findlay
1000 N. Main Street
Findlay, OH 43466

MARY MCLEMORE
Dept. of Humanities
Embry-Riddle Aeronautical University
600 S. Clyde Morris Blvd.
Daytona Beach, FL 32114

GARY A NOVAK
Dept. of Geology
California State University, Los Angeles
5151 State University Drive
Los Angeles, CA 90032

THOMAS P. O'BRIEN
Professional Education
Binghamton University
Binghamton, NY 13902

HERBERT B. POSNER
Dept. of Biology
Binghamton University
Binghamton, NY 13902

LANDRA L. REZABEK
Off Campus Credit Courses
University of Wyoming
P.O. Box 3274
Laramie, WY 82071

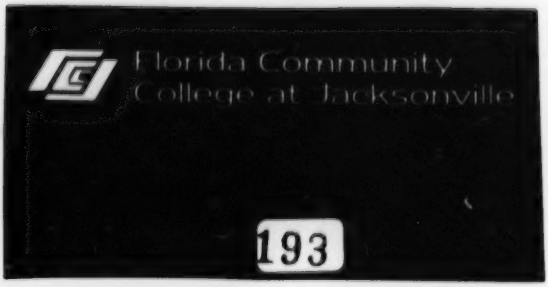
JUDITH A. RICE
Technology Resource Center
Santa Fe Community College
3000 N. 83d Street
Gainesville, FL 32606

NICK RUSHBY
Sundridge Park Management Center
Plaistow Lane
Bromley, Kent BR1 3TP
UNITED KINGDOM

DOROTHY A. SISK
Conn Chair for Gifted Education
P.O. Box 10034
Lamar University
Beaumont, TX 77710

DAVID E. SMITH
National University
8 Executive Circle
Irvine, CA 92714

STEVEN L. YAMSHON
National University
8 Executive Circle
Irvine, CA 92714


Florida Community
College at Jacksonville
193